The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

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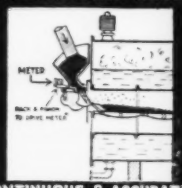

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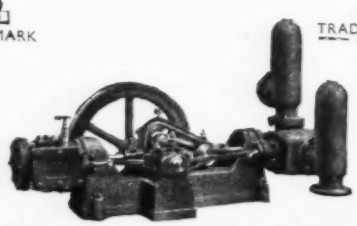

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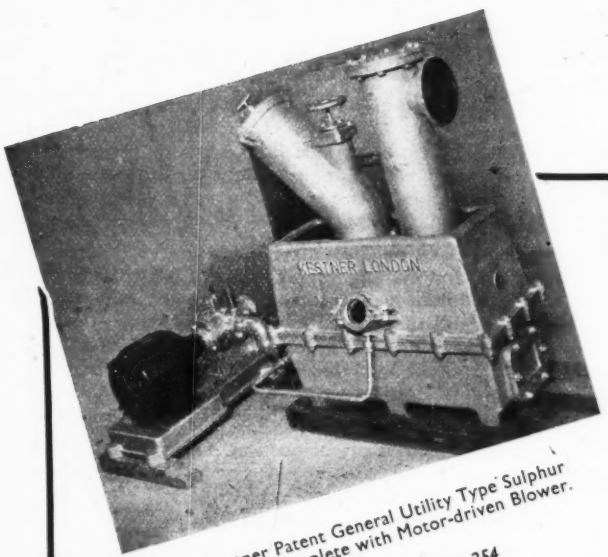

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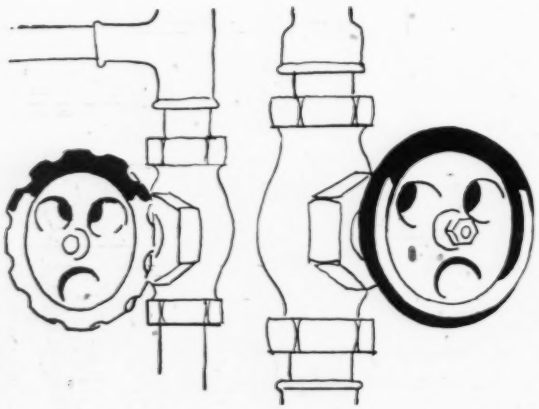

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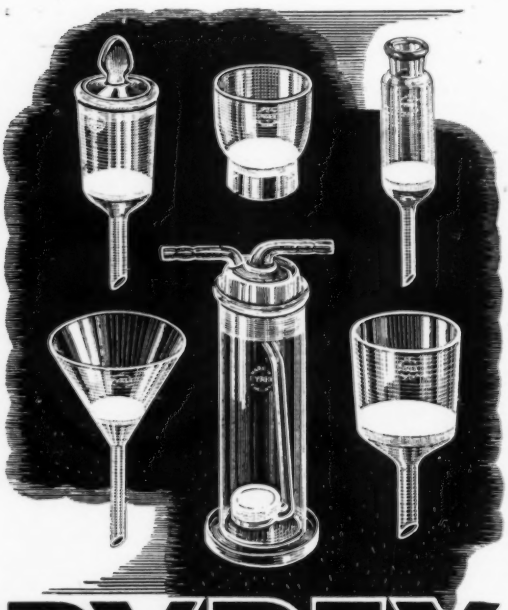

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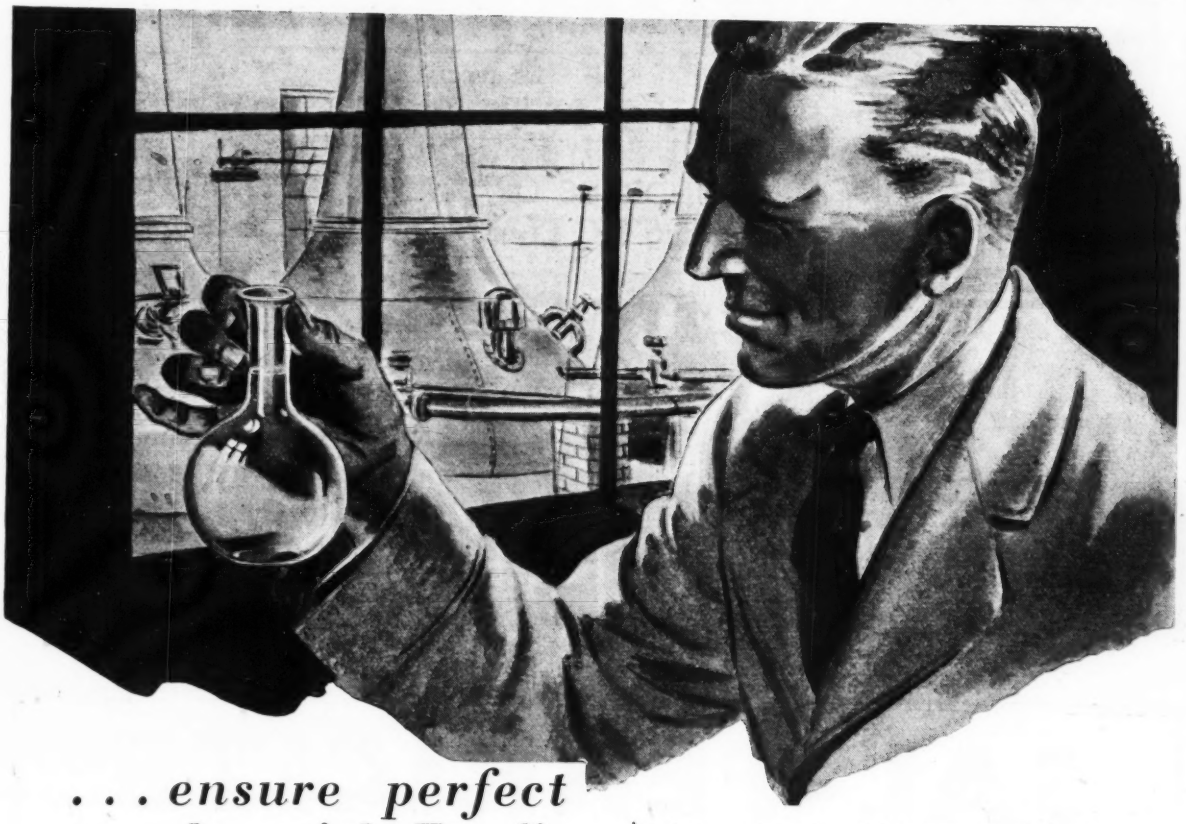

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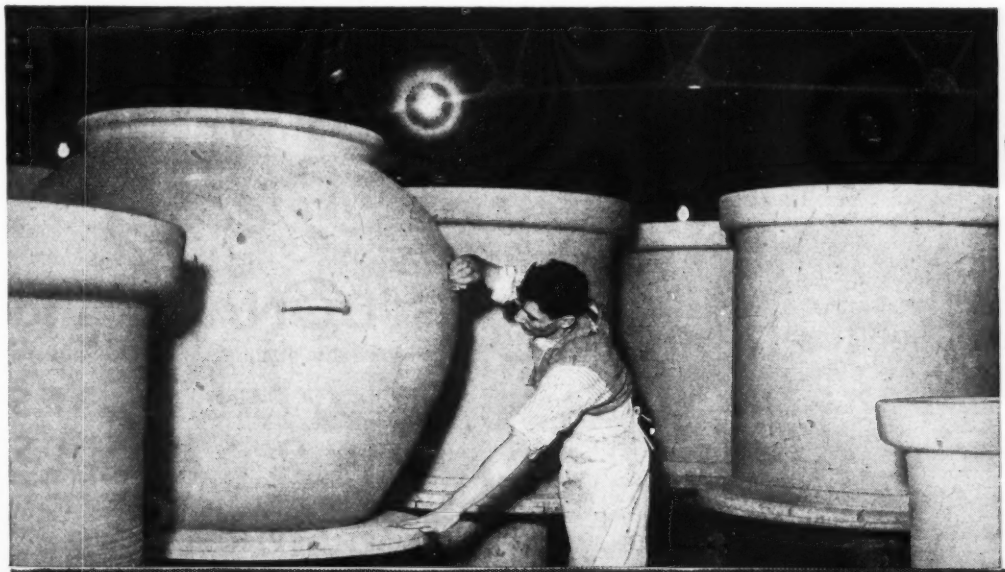

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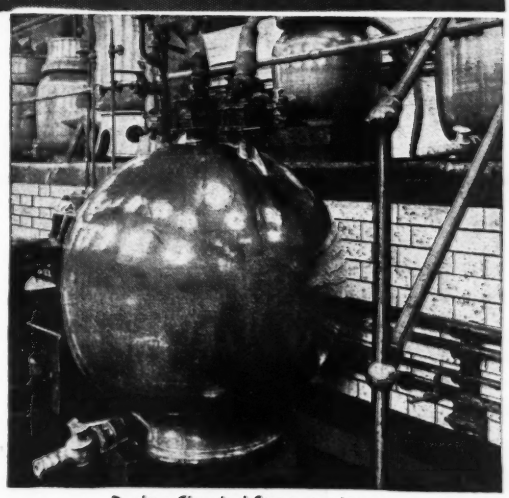

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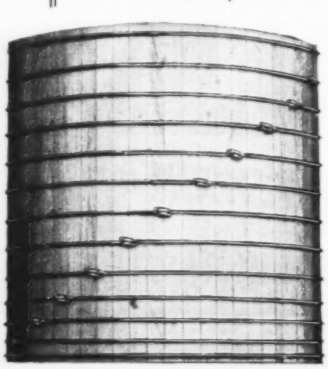

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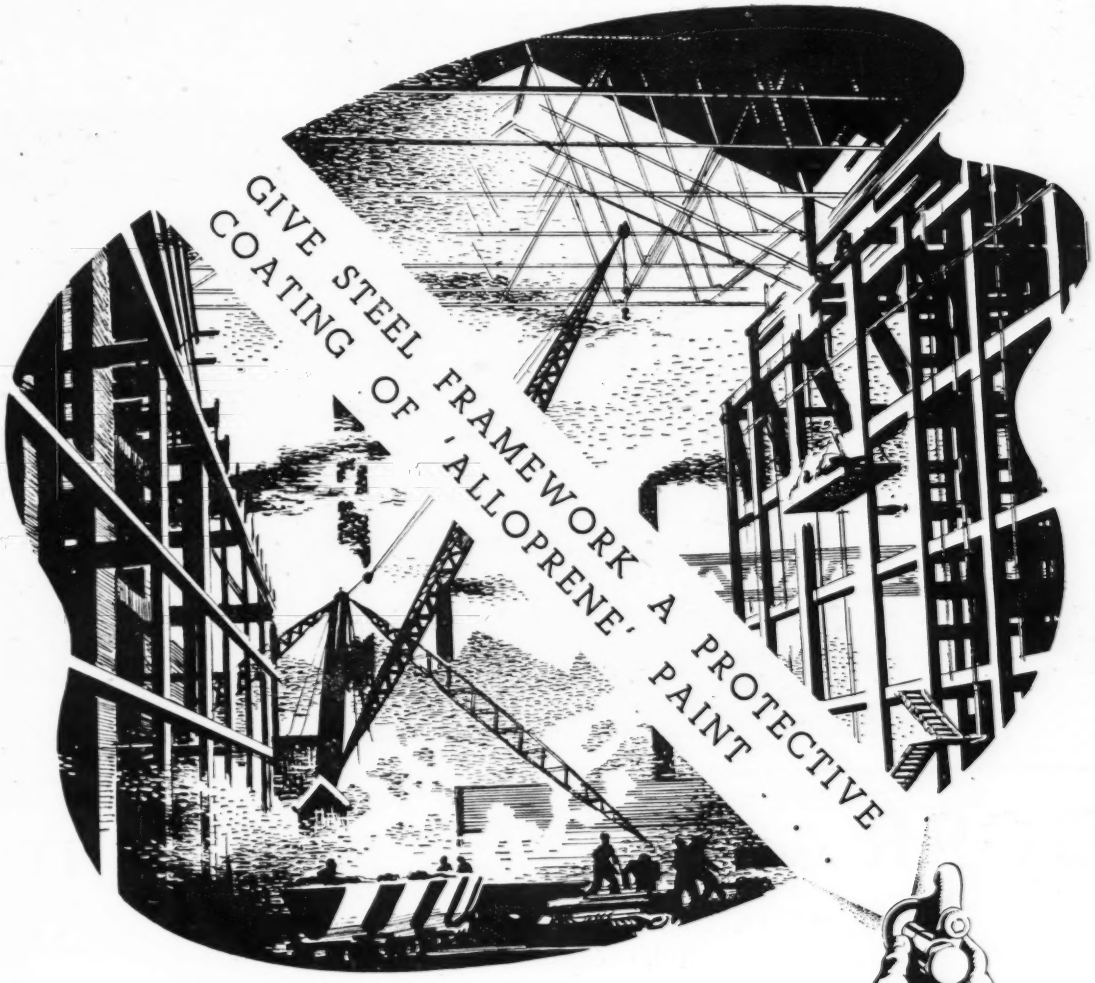

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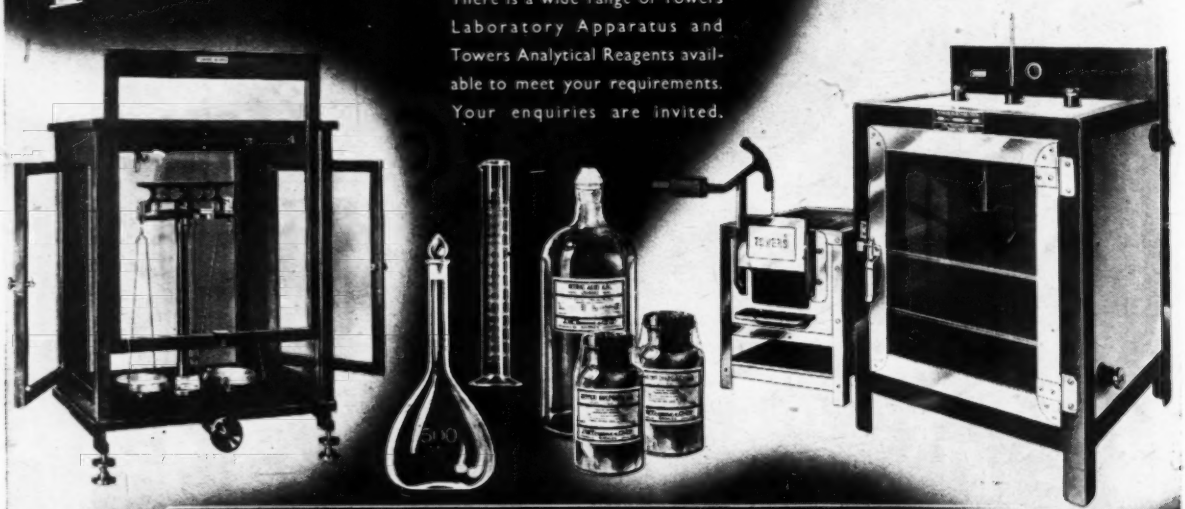

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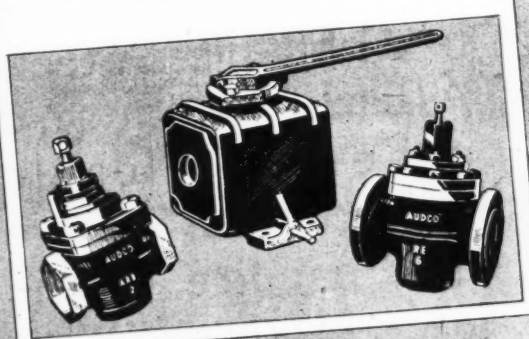

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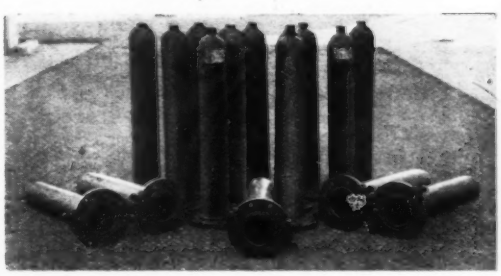

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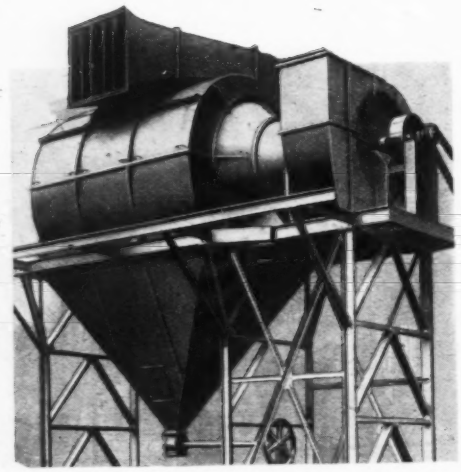

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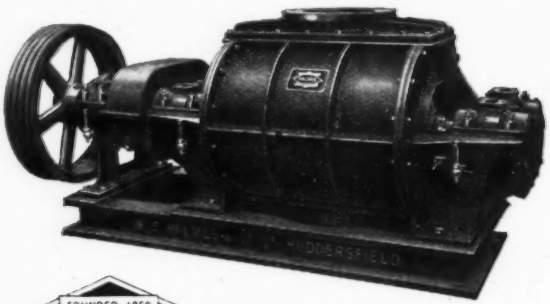

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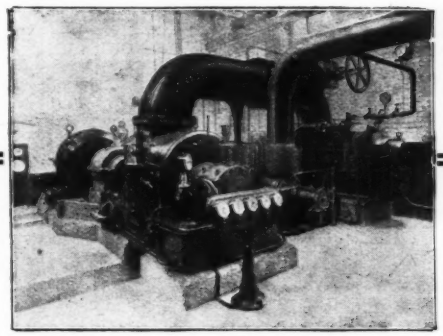

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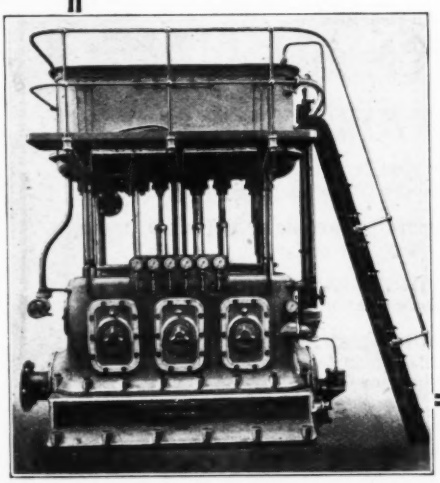

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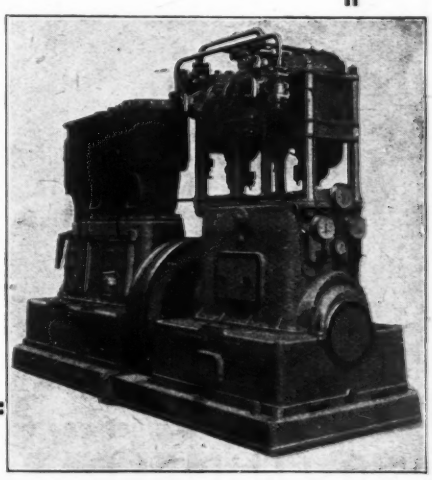

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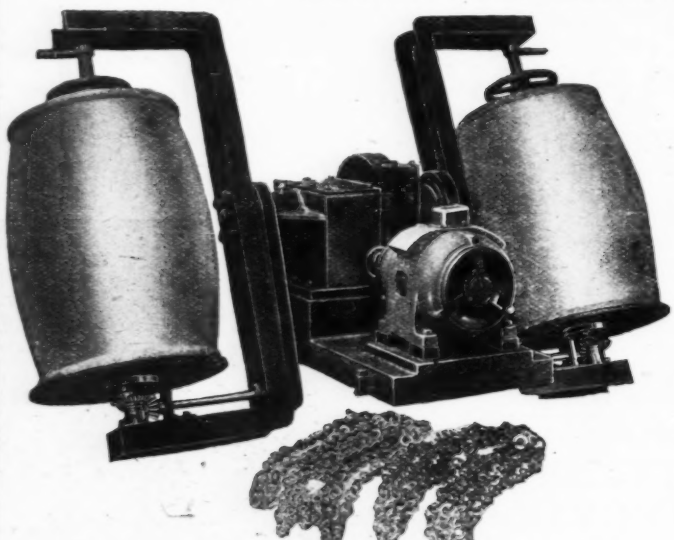

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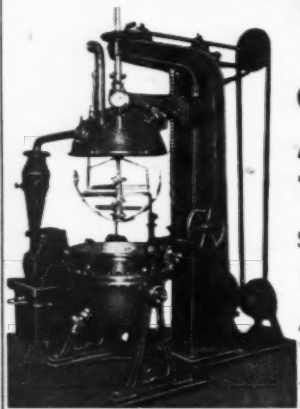

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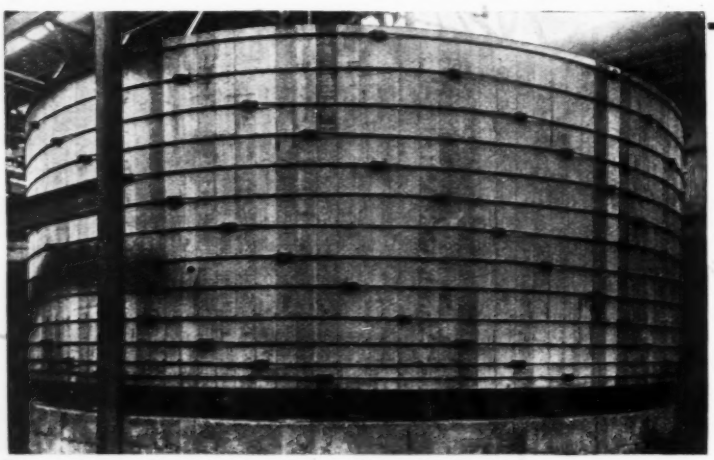

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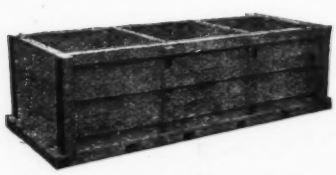

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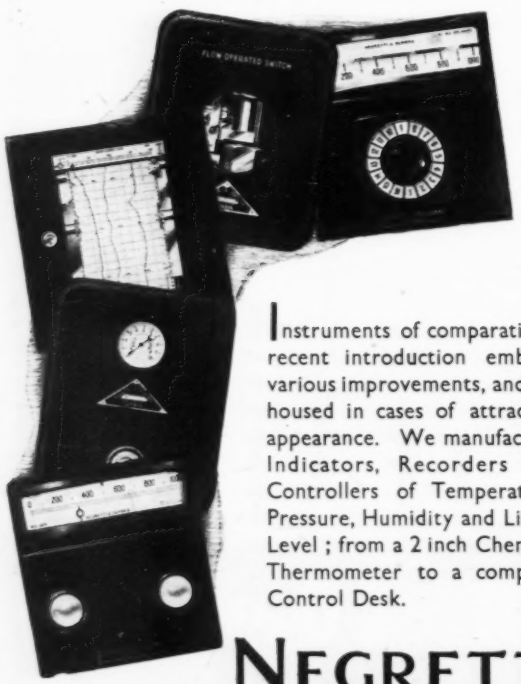

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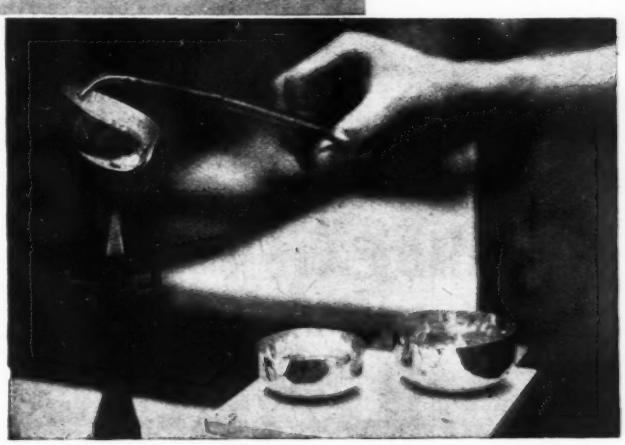

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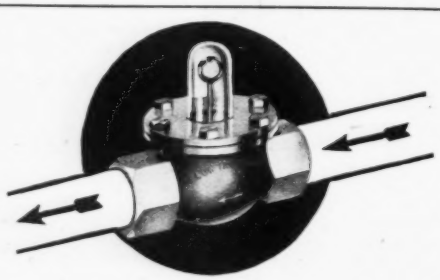

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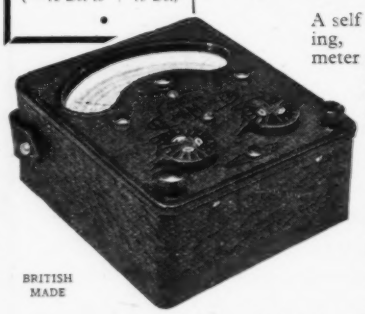

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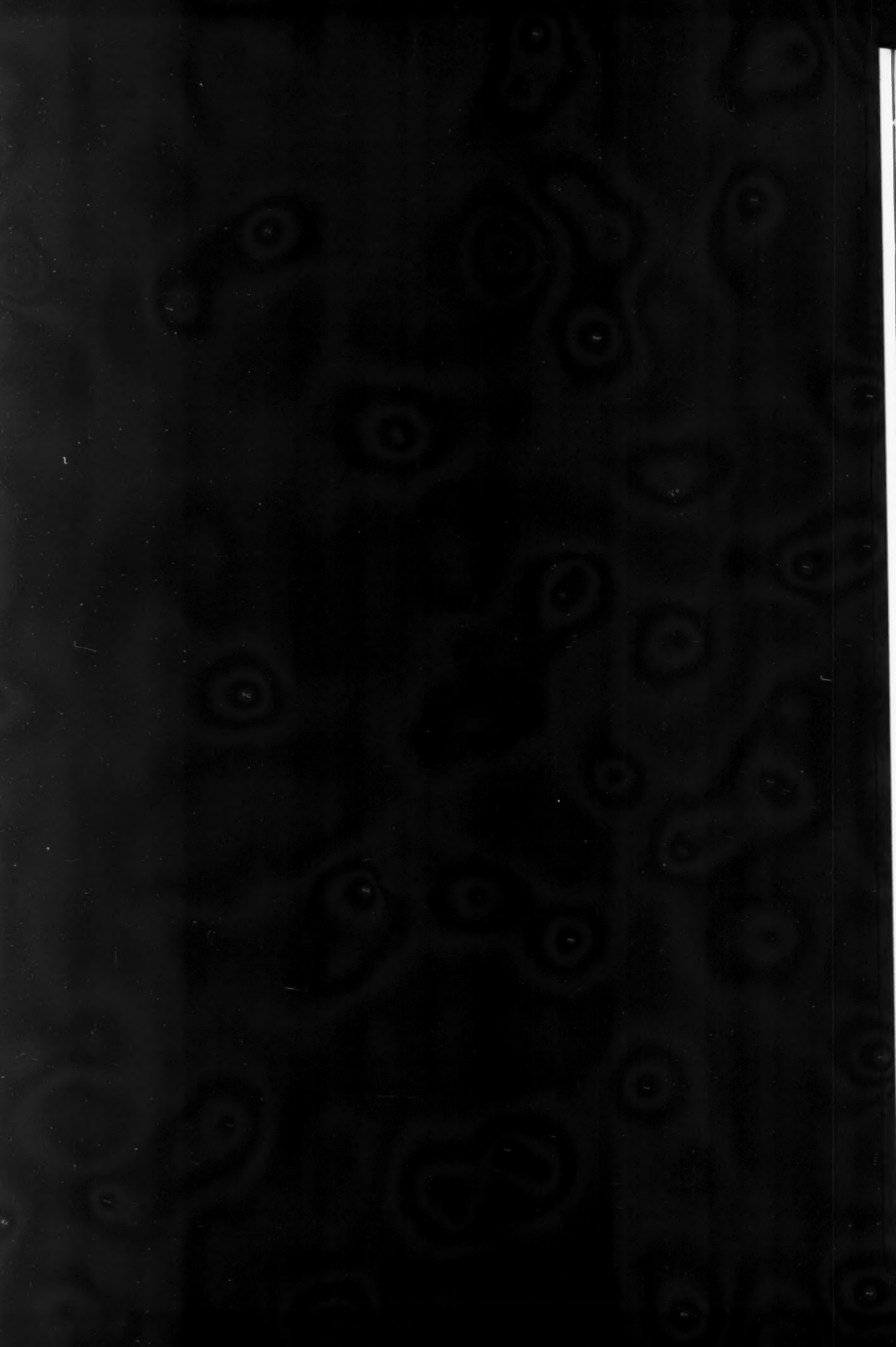

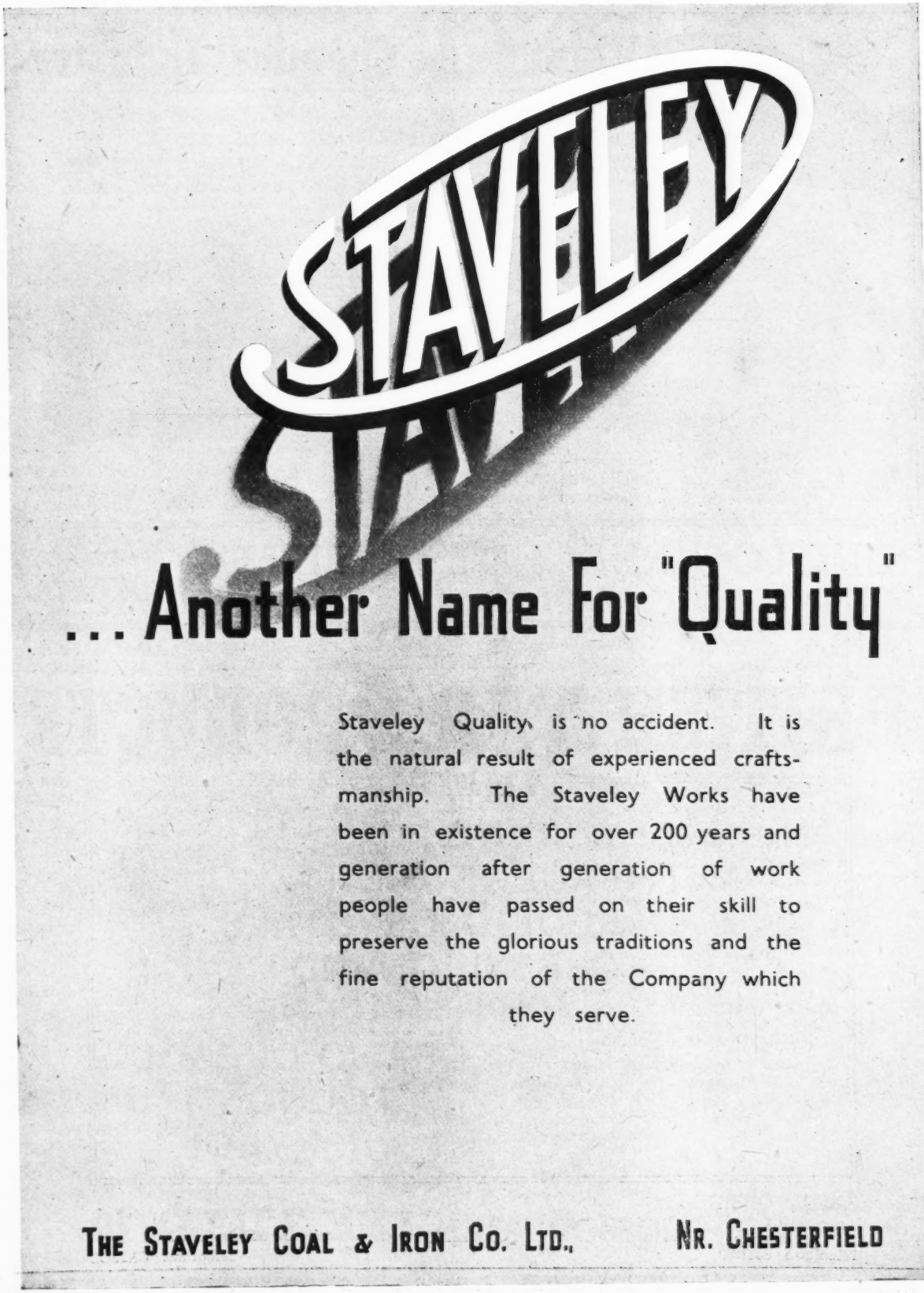
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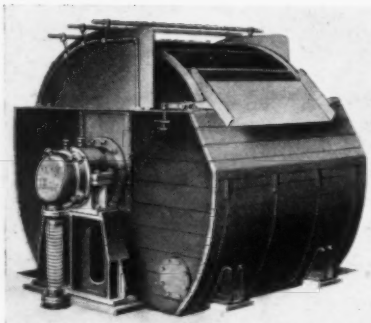

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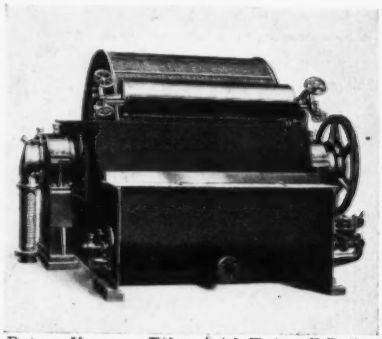

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VOL. XLVI. No. 1176 January 10, 1942 Annual Subscription, 21s. Overseas, 26s.

The Chemical Industry in 1941

THE witch's cauldron which was once Europe has so boiled over since our last Annual Review Number that the whole world is now engulfed in the mess. The effect must be considerable from a business point of view. Those nations already at war, comprising primarily the countries of Europe and the British Empire, have been wholly engaged in the production of munitions, among which chemicals and chemical plant rank very high. There is probably no field of munitions that is not touched to a greater or less extent by the chemical industry. The result has been that customers overseas have not been able to obtain their supplies and have had to be supplied from those nations not at war, for example, Japan and North and South America. It was inevitable that new business relationships should spring up to the detriment of the older-established interests. With the wider character of the war, however, upon which we entered in December, a new position has arisen in that virtually the whole world is now working for the purposes of war, and but little remains of peaceful pursuits.

After the war there will either be ordered organisation of trade both internationally and nationally or there will be intense international competition. For both of these eventualities we must be prepared. It is well that we should be ready to establish trading centres all over the world as soon as hostilities end, in the rather unlikely event of unrestricted competition once more developing. In order to meet the more probable event of world commercial planning, arrangements must be made for individual competition to be sufficiently relaxed to enable each industry to take common action and to enter into comprehensive trading arrangements with similar industries in other countries, certainly from among our allies and probably after the war from among our present enemies.

The year 1941 has been one of intensive activity. There has been activity in research, new technical developments have been brought into play, new ventures have been started; but over all has been a cloud of secrecy. It has happened that all this activity has unfortunately been in the cause of destruction. The organisation of industry in the cause of construction has been further weakened by the Government's plan to concentrate industry and to close down many smaller undertakings. After the war there will be an even greater reorganisation required than after the previous war. Not only will a market have to be found for manufactures now used for war purposes, but plant will have to be turned over to different manufactures, and businesses that have closed will have to be reopened or merged permanently into other undertakings. It seems likely that a considerable period of chaos will intervene if steps are not taken now to prepare the way for an easy turnover from war to peace when this comes. This may be a long war; or it may be that peace with victory is just round the corner. We cannot afford to wait and see.

While it is not possible to disclose developments at home, particulars have been published of some developments overseas. The Canadian chemical war effort, for example, has entailed the building of large new plants. No military explosives were made in Canada before the war, but two small high explosive plants were erected. These have served as a useful training ground and a modern H.E. and propellant plant has been built in Ontario and another in Quebec, the two together covering nearly 2000 acres. A 150-ton-per-day sulphuric acid plant has been erected to supply these factories, using iron pyrites as a by-product from copper pyrites. A third plant is now in operation in Western Canada. Before the war there was only one synthetic ammonia plant in the Dominion, this having a capacity of 100 tons of ammonia a day. Several more plants have been erected and these include certain features and the manufacture of certain other products about which no information can be divulged. Plants have likewise been built for the production of intermediates for the explosives industry. The manufacture of phosphorus, one of the oldest Canadian industries, has now been greatly extended and both red and yellow phosphorus are made. Activated charcoal, phthalic anhydride, toluene, acetone, and nitrocellulose are also made. It is interesting to note that the nitrocellulose plants which used to operate on cotton linters now use a certain grade of Canadian sulphate and sulphite pulp.

The chemical industry is developing in South Africa, too. Superphosphate was originally supplied from Holland and Belgium, and although a little has been made for the past 30 years, by 1919 only 10,000 tons were produced locally. This figure, however, has increased steadily but at a loss for many years, until by 1938 158,000 tons were made at a bare profit by successful squeezing of the sulphuric acid plants with the minimum of capital expenditure. Further plants are being installed to make 260,000 tons per year, the whole pre-war consumption. Calcium carbide plant has been erected comprising six furnaces of the open vertical continuous electrode type requiring some 12,000 kW. Dr. A. G. Viljoen of National Chemical Products, Ltd., has announced that glycerine is being made from molasses in South Africa by an entirely new process. The only details given of this are that the molasses is fermented by a special yeast under alkaline conditions and the wash is concentrated, the glycerine being then extracted by solvents, after which the sol-

vents are evaporated using crude glycerine which can be purified and distilled. The same company can supply all the acetone required in the Dominion by fermentation of maize if imported supplies fail. There is also a plant ready to produce it from the catalytic conversion of molasses-derived alcohol. All the equipment for this plant was made in South Africa. Some 2,000,000 gallons per year of ethyl alcohol are now produced by the fermentation of molasses. This amount would be 7,000,000 gallons, but some molasses is exported and some is run to waste.

In this issue last year reference was made to the importance of carbide production. It is comforting to know that a carbide factory was already in production in this country in the middle of the year and that a second is either in production or will very shortly be producing. There is little doubt that these plants are based upon power derived from coal. In general the year has seen an intensive development of whatever resources this country possesses. One indication of this is that a number of abandoned deposits of barytes, micaceous hæmatite, and ochres have been reopened in order to supply the paint industry. It is hoped that the paint industry will after the war support these mines and that the mines will themselves assist this by further processing of their raw material.

The organic chemical branch of the industry is very lively and it is a liveliness likely to be carried over into peace time after the war. One of these developments is the production of fatty acids from coal. The starting point for this development, which has attained its peak in Germany, has been the Fischer-Tropsch process, and the fatty acids are derived from the catalytic oxidation of the by-product waxes produced by the Fischer-Tropsch reaction. Already in 1937 plants were under construction to produce some 20,000 tons of synthetic acids per year. Even though there has been a certain amount of extra glycerine imported from the Balkans and from North Africa, it is probable that development has been progressive and will have been encouraged by the cessation of imports of Manchurian soya beans since the German attack on Russia. It is no doubt from some such starting point that the Germans are now producing synthetic "butter" from coal and coke. The gases evolved from the processing of petroleum are proving the starting point of a vast chemical industry and in THE CHEMICAL AGE of February 22 last will be found some particulars of the synthetic production of glycerine from petroleum. There is a growing feeling that all petroleum products used in this country should be imported in the form of crude petroleum and refined here in order that the British chemical industry as a whole can participate in the synthetic organic chemical manufacturing processes that are being built up from this raw material. With this and coal as a starting point a vast organic chemical industry could be developed here.

The growth of electrolytic processes is a feature of modern chemical industry and is due to the demand for the production of purer and cheaper products, to the availability of hydro-electric power in certain countries, and to the desire for conservation of natural resources. Perhaps the principal reason, however, is that it is possible to cause reactions to take place with comparative ease which are virtually impossible by other methods. Particulars of some of these developments have been given by Professor Fink, an abstract of his paper being reprinted in THE CHEMICAL AGE on March 29.

As is to be expected in a nation at war, agriculture has bulked heavily in the news. There has been great controversy during the year between agriculturists and chemists on manures. On the one side it has been pointed out that our present methods are denuding the land of humus which is regarded as essential for plant growth. A process has been described whereby humus can be reconstituted from towns' waste and put back on the land. Agriculturists of this school maintain that artificial fertilisers are inadequate and that their widespread and continued use will ultimately be disastrous. Several references to this controversy will be found in THE CHEMICAL AGE during the year, including a description of the process mentioned. On the other hand, Sir John Russell, Director of the Rothamsted Experimental Station, in a paper to the Society of Chemical Industry has summed up the evidence thus: "There has been a good deal of misunderstanding about organic manures, and not a little arrant nonsense has been written on the subject. Some people have supposed that there is some special virtue about the so-called natural plant food that comes from animal and vegetable sources, as compared with the so-called artificial plant food prepared from mineral substances. There is no evidence that it is so. It is, of course, true that farmyard manure and plant residues given in sufficient quantity—some 10 or 15 tons per acre—increase the humus in the soil and so improve its physical condition as well as supplying plant food. But there is no evidence that the nitrogen in farmyards has anything like as good value as the nitrogen in sulphate of ammonia or nitrate of soda; indeed, it is usually only about half as effective."

The year under review has seen the chemical industry vitally alive in every direction. We recorded last year how the trend of Japanese industry was in the direction of gradual diversion of the industries of that country to those that make use primarily of air, water, and coal as their raw materials. It seems likely that this trend of utilisation of home materials will be intensified in many of the countries that are at war, since transport is likely to play an overwhelming part both in war and also in peace. In war it is the difficulties, delays, and uncertainties of transport that count; in peace it is the cost of transport. Unless transport becomes easier and cheaper there must inevitably be a tendency, in developing chemical manufactures all over the world, to rely on home raw materials or on such raw materials as can be transported cheaply, unless the cost of the finished product is considerably higher than the cost of the raw materials. After the war thorough attention must be paid to the organisation and regulation of international transport.

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CONDITIONS IN, AND SOME WAR PROBLEMS OF, THE HEAVY CHEMICAL INDUSTRY IN 1941

By

P. PARRISH, F.I.C., M.I.Chem.E., M.I.Gas E., F.I.I.A.

Mr. P. Parrish

THE year 1941 has witnessed an extension of the war: indeed, it is now almost world-wide in its extent. The problem now to be solved is greater in scope and complexity than any hitherto faced: in short, it is to organise strategy and supplies on a world scale, with the single purpose of destroying the aggressors.

Not only has control of many essential materials been further extended during the year, but a Chemical Control has been established to deal with questions relating to supplies of chemicals falling within the scope of the Raw Materials Department of the Ministry of Supply. The fertiliser trade and tar products industry are also under control. The Secretary for Mines has now, under the Order, a very wide measure of supervision over the whole industry and trade. Maximum prices for any of the materials, national or local, can be, and indeed have been, fixed. The direct importation into Great Britain of any coal tar or coal tar products was excluded from the purview of the Order. Experience of aerial attack led to the abandonment, in some factories, of the usual 8-hour shifts for chemical process workers, and the substitution of a shift involving 12 hours on and 24 hours off.

The Chief Inspector of Factories has made clear, in his Report for 1940, that the Factories (Canteens) Order, 1940, is the first legal Order that has required canteens in factories, although many Orders under former Acts have required mess-rooms. The new Order relates only to factories employing more than 250 persons engaged directly or indirectly on works held essential to the war effort. For works employing fewer than 250 persons, the possibility of joint canteens to serve a number of small works in the same district has been explored.

Are chemical workers, as distinct from workers in the metal and other heavy industries, being adequately fed? This question has been raised, and while no unanimity of opinion has been reached, a few words may not inappropriately be said about the resources and adaptability of the aggressor chemists in nutritional chemistry. Reich chemical concerns are producing increasing amounts of vitamin tablets and distributing these to metal and other heavy workers, to increase their vitality in the spring months, when fresh vegetables are not available. Again, the fat content of milk has been raised by about 12 per cent. without interfering with its other properties, by adding, in suitable form, vitamins B_1 and B_2 to cattle food. Further, insufficient cattle food in northern Europe has resulted in the development of a suitable protein cattle food by a process for the conversion of wood to sugar. Eight fodder factories, manufacturing from wood pulp, are to be erected in Germany.

It is felt that workers in the heavy chemical industry, particularly those occupied in the manufacture of sulphuric, nitric and hydrochloric acids, and mixed acids, are entitled to acid-protective clothing without coupons. It has been indicated that certain items of clothing as applying to chemical workers can be obtained without coupons provided that the local Inspector of Factories is prepared to grant an alternative certificate.

The preservation of our factories and offices against aerial attack is a matter of vital importance, and the necessity for the Fire Prevention new order was obvious. Apart from fire-watching and the availability of fire-fighting crews, experience has revealed how important it is to have several sources of supply of water, and how that water can be applied more effectively, and with less damage to property, in a highly atomised form.

It is apposite here to refer to the War Damage Bill, described by the Chancellor of the Exchequer as "the most complicated measure I have had to deal with." The maximum grant for immediate payment in the case of small businesses is £800. On determining the value of the property destroyed, it is proposed to substitute the purchase price for the March, 1939, value, but for those properties acquired before January, 1932, the value is to be taken, instead of the purchase price. Provision is also made for the Inland Revenue to determine the value of such property, in the event of a dispute.

Nazi Consolidation

Last year reference was made to Nazi chemical gains: this year one cannot refrain from drawing attention to Reich re-organisation plans for Europe's chemical industry, directed to self-sufficiency.[1] A self-contained industry is the aim of the I.G. The "New Order" pre-supposes Nazi victory, and calls for the rebuilding of chemical plants located in areas best adapted to available raw materials and cheap power or labour. Electro-metallurgical and electro-chemical industries, *inter alia*, are contemplated. These would be established where electricity is cheapest—in other words, where hydro-electric plants are available. Norway would supply synthetic fertilisers to France, Spain and the Balkans. France, in turn, would supply Norway with the bauxite needed for the manufacture of aluminium, and Greece would supply magnesite required for the production of magnesium. Yugoslavia, capable of establishing an electro-chemical industry on the basis of water-power and labour, would become the hub of the Balkan chemical industry, with Bulgaria and other Balkan countries supplying raw materials. In Rumania a specialist chemical industry would be integrated around the mineral and vegetable oils occurring there. In France, bauxite deposits would be more completely developed and the organic chemical industry, already well-established there, would be enlarged. Swiss rivers, also a source of power for the electro-chemical industries, would be taken advantage of to the full. Hitherto Switzerland has imported practically all its raw materials, chiefly from Germany, France and Belgium, at the same time exporting 95 per cent. of its total output. Switzerland and Italy are indifferently placed because of the lack of coal, and this, along with the heavy industries, remains under German control. Italy's contribution would be to supply mercury and sulphur to other countries, and Spain would contribute pyrites, *i.e.*, sulphur, copper and iron. These plans, requiring syndicates for the organisation and distribution of production, have already been partially brought into being. A new company, the Nordische Aluminium A.-G., was recently organised in

Berlin, with a capital of 20 million RM., for the production of aluminium and alloys in Norway. Previously, the Norwegian aluminium industry was largely financed by American and British capital. To the Norwegian fishing industry has been assigned the job of feeding the continent under the New Order, and advantage, of course, is being taken of Norway's iron ore and smaller deposits of pyrites, nickel and copper. She has also a tolerable-sized ferro-alloy and nitrate industry. Under German supervision Norway has concluded agreements on a clearing basis with other countries coming under the blockade, chiefly Denmark and Sweden.

Sweden's position is unenviable. In that country a new sulphuric acid plant has been erected for a company proposing the conversion of wood to sugar, which is the first to be state-guaranteed. Two plants are to be installed, with an annual throughput of respectively three and five million litres of alcohol. Sweden is also attempting to develop its shale deposits. Denmark is suffering severely, but its superphosphate company is now producing crude carbolic acid by the distillation of coal tar. Hungary, producing chemicals only to the extent of 6 per cent. of the total industries, would remain a raw material supplier. But in Rumania, the acreage planted in cotton is expected to be doubled, from 50,000 to 100,000 acres: that of flax would be increased to 200,000 acres, of castor beans to 2500 acres and of sunflowers to 800,000 acres.

That this country cannot afford to be complacent is all too evident. It is vitally important that our man (and woman) power should be judiciously utilised, and that the doctrine of unremitting effort should be repeatedly proclaimed. The utilisation of waste products must be more vigorously pursued. Large quantities of waste materials remain unutilised, despite the fact that economic processes can be applied. Sewage sludge could be advantageously used more extensively. Important indigenous materials appear to be at a discount.

Aluminium and Magnesium

Coming now from the general to the particular: a world-wide war brings into immediate prominence the primary importance of (a) available cheap power, combined with (b) abundant natural resources, which are (c) strategically disposed.

In the author's reviews of 1939 and 1940 reference was made to the significance of aluminium as a raw material of prime necessity in the construction of aircraft. The loss of supplies of bauxite from France led to the necessity of this country securing supplies from British and Dutch Guiana and the Dutch East Indies. If our supplies from the latter source are menaced by Japan's predatory activities in the Pacific, fortunately British and Dutch Guiana and Mobile (U.S.A.) have adequate supplies for all requirements. Indeed, the prospective production of aluminium in Australia and America seems prodigious.

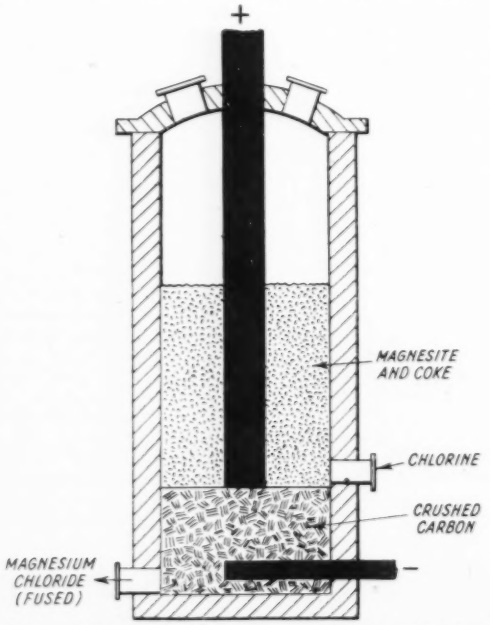

Fig. 1. Chlorinating tower for magnesite (I.G. type)

The demand for magnesium is sensibly increased for war purposes, and large plants in this country and America have been installed. Incendiary explosives and flares account for a large proportion, although extensive use is now made of the metal for aircraft castings and for modern skeleton bodies of all kinds of cars. With the developments referred to, it is not surprising, therefore, that an active interest has been shown in the various electro-chemical processes available for its production. A comprehensive review of the methods at present in use, or in process of development, has been contributed by E. V. Parnell.[2] Fundamentally, the electrolysis of magnesium-potassium chloride, as originated by the Griesheim-Elektron A.-G. in 1896, has been carried on to the present day. Native carnallite is still used, as well

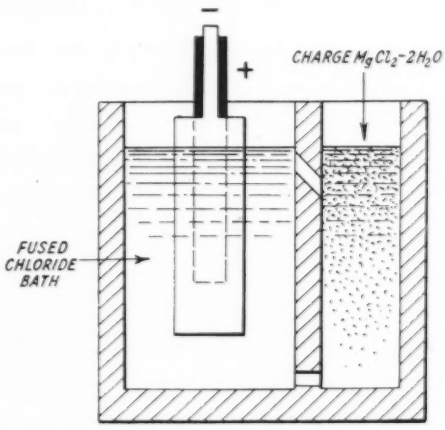

Fig. 2. Combined cell for dehydrating and electrolysing magnesium chloride (I.G. type)

as mixed chlorides and straight magnesium chloride. Owing to difficulties associated with the necessary dehydration of the salts, however, the dry method of producing anhydrous magnesium chloride is favoured. This involves the chlorination of magnesite or magnesia. Fig. 1 represents the I.G. type of chlorinating tower for magnesite. The following details will be of interest.

A resistance furnace is used, in the form of the tower shown, provided with a vertical electrode extending downwards from the roof, and a second electrode at the base, embedded in crushed carbon. The tower is charged with crushed magnesite and coke, and chlorine derived from the electrolytic reduction process is fed to the base of the tower, while maintaining the temperature at 700-900°. The carbonate is thus converted to the chloride, which is tapped in the fused condition and run directly to the electrolytic cells. Pre-calcination of the magnesite is advantageous, as chlorination of the oxide appears to give smooth operation and better yields. When dealing with dolomite the mixed carbonates are calcined, the product leached with magnesium chloride and the insoluble magnesia dried and chlorinated in the usual way. Where mixed chlorides are used the Japanese Suzuki cell, or the I.-G. cell (*see* Fig. 2) is employed. For the reduction of magnesium chloride the rectangular type, with a capacity of 15,000-20,000 amps., is most widely used. Fig. 3 represents the Koehler furnace for this purpose. A temperature of approximately 750° is usual, with voltages of 7 to 9, and an energy consumption of 9 kWh per lb. of metal. Electrolytes consist of mixtures of magnesium, potassium and sodium chlorides, varying between wide limits, but

usually containing between 10 and 70 per cent. magnesium chloride.

The basis of electrothermal methods is the reduction of magnesium oxide with carbon at 2000° by means of a three-phase electric arc, followed by dilution and cooling of the

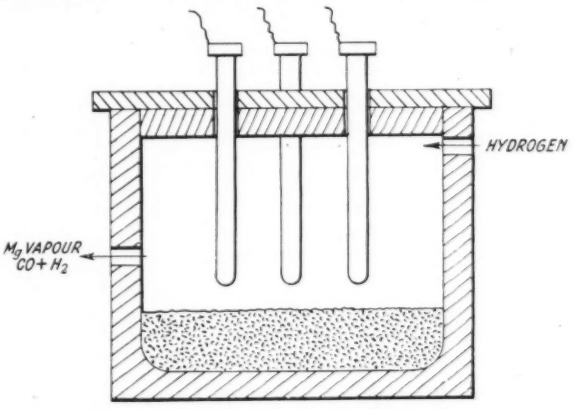

Fig. 3. Koehler furnace for magnesium production

reaction products with an inert gas. If the reaction products are cooled normally, the reaction $2MgO + C = Mg_2 + CO_2$ is reversed and the yield of metal is negligible. Sudden chilling and dilution, however, produce high yields. Cold hydrogen or hydrocarbon gas is therefore introduced directly into the gas stream from the arc furnace, to dilute and cool the mixture suddenly to 150-200°. Metallic magnesium is thus precipitated as a dust containing some magnesia and carbon, entrained from the furnace. This dust is then briquetted with oil, distilled *in vacuo* at 750-950°, and the metal collected as a powder under a hydrocarbon oil. The metallic powder is finally melted and cast into ingots. The residue from the still (MgO + C) is returned to the process, while the gas mixture from the condensers (hydrogen and carbon monoxide) is treated for the catalytic oxidation and removal of the carbon monoxide, and the hydrogen is returned to the process. Data from the operation of the process as originally developed by Hansgirg at Radentheim gave an approximate power consumption of 22,000 kWh per ton of metal, a yield of approximately 80 per cent. throughout as high-quality ingot, and a hydrogen consumption of 4 cu. ft. per lb. of metal produced. Installations of this process, with certain modifications, have been made in this country and in Germany. Production by this method on a much larger scale than hitherto is in process of development at Palo Alto, Calif., U.S.A.[3]

A new method of recovery, due to Blackwell and Turner, utilises a high-frequency induction furnace and a solid reducing agent such as ferrosilicon or calcium carbide. The magnesia and reducing agent, finely-ground and intimately-mixed, are charged into the central chamber of the furnace (Fig. 4), which is closed and evacuated while the primary winding is subjected to a current of 10,000 to 50,000 cycles per second. Magnesium is vaporised, and condensation takes place on the inner surface of the dome, which is provided with a cooling coil. When the reaction is complete the dome is heated by means of an electric winding, and the liquefied magnesium is collected from a tapping hole. This process is said to be the simplest and most foolproof yet devised, and marks a definite advance in the commercial production of magnesium.

Several recent patents dealing with the recovery of magnesium may be briefly mentioned. For the treatment of sea-water prior to the extraction of magnesium, the calcium is precipitated by Na_2CO_3, $MgCO_3$, or $Mg(HCO_3)_2$, *e.g.*, synthetic magnesium carbonates may be added, or the water passed through a bed of dolomite.[4] For the recovery of magnesium from serpentine,[5] calcination at approximately 700°, followed by grinding and leaching by bubbling CO_2 through an aqueous suspension is proposed. By this means about 30 per cent. of the MgO content dissolves as $Mg(HCO_3)_2$, which is precipitated as basic carbonate by boiling the solution. Magnesia is then produced by calcination. A readily-filtrable $Mg(OH)_2$ is said to be produced[6] from bitterns containing $MgCl_2$ or NaCl by using it to slake lime, and converting 25 per cent. of it into $Mg(OH)_2$, the addition being at such a rate as to maintain the mixture as a hot plastic mass. When the slaking is complete further bittern is added to convert the CaO to $Ca(OH)_2$ and form a thin slurry of $Mg(OH)_2$, which is separated by filtration.

Magnesium hydroxide in an easily-filtrable form may be obtained from dolomite by first calcining in the presence of a small amount (2 per cent.) of a compound providing B or Be (razorite, beryl, etc.), then crushing and adding to a solution of magnesium chloride and calcium chloride, and finally separating the precipitate by filtration.[7]

Another process[8] for the recovery of magnesium hydroxide from dolomite consists in treating an aqueous suspension of the calcined mineral with CO_2 to convert the CaO to $CaCO_3$. When the MgO is fully hydrated, H_2S is passed into the suspension to form Mg(SH). Magnesium hydroxide is precipitated from this solution by boiling, and the H_2S thus generated is used again in the process.

Reference should be made to two other metals—manganese and beryllium. Manganese is largely used in steel manufacture for armoured plates, and one finds Canada

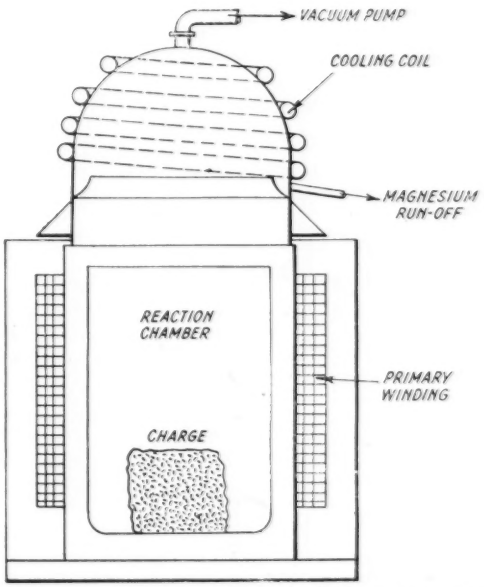

Fig. 4. Blackwell-Turner induction furnace for producing magnesium

interesting itself in a cyclic process for the extraction of manganese from its ores and the recovery, through electrodeposition, of substantially pure metallic manganese. This process is described in B.P. 525,246 of 1940, granted to the Consolidated Mining and Smelting Co., Ltd. (of Canada). The merit of beryllium resides in its use with copper in the manufacture of copper-beryllium alloys of excellent mechanical properties, combining light weight.

Some High-Explosives Problems

Frequent questions are asked about the type and characteristics of the explosives being used in the present world-war. The position[9] may be summarised thus: primary explosives are characterised by their great sensitiveness to heat, shock or friction. They initiate the explosion of the main charge of either propellant or high-explosive. Mercury fulminate and lead azide come into this category.

Propellants have a relatively slow rate of burning, and the pressure is built up progressively. Black powder was originally used for this purpose, but the current propel-

lants are smokeless powder with a nitro-cellulose base and cordite. These are used almost universally.

High-explosives have a high rate of detonation, 2000/9000 metres per second. They have a high shattering power, and are used as a bursting charge for shells, bombs, and torpedoes.

The high-explosives in general use are TNT, DNT, Amatol (various mixtures of ammonium nitrate and TNT), and explosive D (picric acid and ammonium picrate). What favours the use of TNT is that it is stable, and can be loaded in liquid form, and it gives a satisfactory fragmentation. It is slightly sensitive to shock and not easily detonated by a primary explosive.

Boosters are sensitive high-explosives. Less sensitive than initiators, they are used in the explosive train between the initiator and the bursting charge, to facilitate detonation of the last-named. Tetryl (tetranitromethylaniline), and hexyl (hexanitrodiphenylamine), are the most important of the booster type of explosives.

Some interesting details have been published about the manufacture of lead styphnate. This product is apparently used in conjunction with lead azide and tetryl in the manufacture of Briska—a gaseous delayed-action detonator used in South Africa as a mining explosive. Sulphonated resorcinol, maintained at 33° C., is nitrated, after which the styphnate-azide (2:4:6-trinitroresorcinol) is floated to the top of the waste acid, separated, washed and dried in a vacuum filter. The sulphonic acid is stored until required for precipitation, which is effected with magnesium oxide: subsequently, the diluted solution is precipitated with lead nitrate.

A study of the composition of ammonal, Alumatol, Amatol, gun-cotton, Blastine, Sabulite, TNT, gelignite, and picric acid, reveals that every one contains ammonia-nitrogen, nitrate-nitrogen, or a nitro compound. The ammonium nitrate content of some reaches as high as 65 to 80 per cent. by weight of the complete explosive. Many of the military explosives of to-day are simply those of the last war: but there are, of course, new ones, some of which remain a secret.

Economic Acid Concentration

In previous years the author has referred to the concentration of waste acids arising in the manufacture of TNT, nitro-glycerine and nitro-cellulose, etc. In a paper on this subject particular reference was made by the author to concentration in heated vessels, and it was emphasised that a study of the physico-chemical principles involved made evident that the ideal form of concentrator for weak waste acids was one in which direct pre-concentration was effected by the waste heat from the pot stills used for final concentration. A provisional patent covering this principle, and embodying novelties of design, has been applied for. By the new process the fuel consumption need not be more than 10 to 12 per cent.

Further intimate experience of this problem reveals the following aspects as essential to foolproof working. (1) The cast iron pot should be suspended, and should be supported in such a manner as to be independent of the brickwork of the setting. (2) Adequate incandescent refractory brickwork should be available for heat transmission, as the capacity of a given unit depends largely on the temperature head and heat capacity. (3) Hot gases should be circulated around the cover of the pot, in order to maintain a satisfactory life of this part of the equipment. (4) Dephlegmators constructed of heavy chemical sheet lead, suitably lined with obsidianite bricks and provided with a grill and carefully-graded quartz, have proved peculiarly efficient, whereas the bubble-and-cap type dephlegmators made of silicon iron are susceptible to annoying fracture, with the result that sensible losses of acid occur in the effluent from the jet condensers. (5) The connecting pipes from the stills to the coolers must be maintained full of acid if corrosion is to be avoided. Cast iron, or acid-brick-lined C.S. lead coolers are equally effective, if the many minor points of design are adequately appreciated and legislated for.

With some weak waste acids organic compounds are held in solution, and as the concentration increases gels develop, which are dehydrated on further concentration, with the result that carbonaceous deposits are formed. Ultimately these deposits may reach the acid in the pot still, with the result that a rapid evolution of CO_2 and SO_2 occurs for a short time, and the volume of gases is in excess of that for which the dephlegmator was designed. Thus, pressures are set up which can have annoying consequences temporarily. How to overcome these exacting conditions is now clear.

Activated Carbon

Many of the manufacturers of this country depend on Ceylon carbonised coconut shells as the source of their raw material. The characteristics of these shells are not always uniform. It is better to carbonise shells under conditions which are known, and which can be controlled chemically and physically. It is believed that if this practice were pursued, larger throughputs from activating plants would result.

In the process of activation it is important to be able to maintain the carbonised shells under fairly uniform temperature conditions, of the order of 750-850° C., and that superheated steam, with a regulated amount of air, should be applied in quantity of say 2 lb. of superheated steam per lb. of activated carbon produced. Time contact for reaction is important, if a volume activity of 12-14 is to be attained. To get a temperature of 750-850° C. in the activating retort involves temperatures of 1200° C. in the surrounding flues, and clearly, steps should be taken to generate steam in a tubular boiler with superheater, if the process is to be economical, from a fuel point of view—so essential a condition of operation to-day. It is felt that the sizes of plants in this country are too small, and consequently lack the supervision which larger units could warrant.

Synthetic Ammonia

The occupation of more European countries during the last twelve months by the Germans has not appreciably increased that nation's productive capacity of synthetic ammonia. But it is interesting to note that in the second United States programme, large synthetic ammonia plants are to be erected by Commercial Solvents and by Hercules Powder, at estimated costs respectively of $15,807,086 and $16,073,800.

Very little has been published during the year concerning new catalysts or improved technique in the manufacture of synthetic ammonia. What is interesting in this connection is the foolproof method by which hydrogen for the inflation of balloons is manufactured in outlandish places. Ferro-silicon is used, which is ground to a uniform mesh of 30. Generators are provided, in which a reaction is effected between a 10 per cent. solution of caustic soda and the ferro-silicon. The hydrogen is collected in suitable small receptacles and pumped into the balloons. It is estimated that it costs 30s. per 1000 cu. ft., whereas the hydrogen generated for the balloons in this country by the water-gas process is estimated to cost about 6s. 6d. to 7s. 6d. per 1000 cu. ft., compressed into cylinders. In the water-gas process of hydrogen generation the quantity of caustic soda used per 1000 cu. ft. of hydrogen generated, for the elimination of the CO_2, varies between 0.4 and 0.8 lb. There is apparently a need for a more efficient washer, in order that the minimum figure indicated may be maintained. It is learned that experiments with a French process, in which caustic soda was injected at 1000 lb./sq. in. into a pressure vessel containing a pre-arranged quantity of graded ferro-silicon, with the object of discharging hydrogen under pressure into cylinders, have not proved outstandingly successful.

Fuel and Gas Industries

Much could be written about these industries. But brevity is necessary in these days. The Mining Industry Essential Work Order was drafted in March, introduced in May, but it was September before there was a clear realisation by those immediately concerned that the fullest possible output of coal was of vital importance to the war effort.

Many anomalies call for adjustment; not the least is that existing between coal charges and the price of gas. Control

of coal prices is presumably in the hands of the Ministry of Mines, who cannot fail to realise the injustice to which gas undertakings are put, in forbidding them to increase their charges without official sanction. Meanwhile, gas undertakings are placing the Government under additional obligation by their response to the Directions recently issued by the Board of Trade, making it compulsory for them and coke ovens with installed plants to treat all their gas for the fullest practicable recovery of benzol and toluol. In 1936 it was estimated that 20 million gallons of crude benzol was produced at gasworks in this country yielding 12½ million gallons of motor spirit. It has been observed that if all gasworks recovered benzol to the equivalent of the coke ovens, a further 20 million gallons of motor benzol per year would result. That this target will be aimed at cannot be doubted, although it must be remembered that many benzol plants have been designed to recover only 1½-2 gals./ton of coal carbonised, which represents a 50-60 per cent. recovery. With slight modification, additional oil circulation at 15° C., better heat exchange and improved supervision, there is no reason why an additional recovery of 20-25 per cent. cannot be attained.

Meanwhile, gas undertakings are seeking to extract ammonia from crude coal gas more efficiently, and in higher concentration as gas liquor, so that concentrated gas liquor plants can operate to better advantage.

The Pitch Marketing Board and others in the trade are popularising the use of pitch in liquid form, or in pulverised condition, as a suitable fuel for the generation of steam in Lancashire and tubular boilers. Interesting large-scale trials have been made to determine how far it is possible to use light vertical retort creosote in Diesel engines. Although it is not possible to use this creosote without blending, the relatively large quantities of Diesel oil imported are such that there is ample outlet for creosote in this direction. A blend of 25 per cent. creosote and 75 per cent. normal petroleum oil has been used in the engines of three buses, and the running was found to be eminently satisfactory.

In October last the appointment of Dr. E. W. Smith as Director-General of Gas Supply was heralded with satisfaction. The dual purpose of his appointment is to deal with immediate questions relating to public supply of gas to nationally-essential factories, and to advise on the necessary steps to ensure the progressive development of the industry as a national service.

Sulphur

It is not surprising to find that more than usual attention has been directed to the recovery and efficient utilisation of sulphur. This subject is one which is assuming increasing importance, and although much has been achieved during the past few years, there is no doubt that, for obvious reasons, greater effort is necessary toward national self-sufficiency in this important raw material. In this connection it is interesting to note[10] that measures are being taken by the Spanish Ministry of Industry to exploit her pyrites resources in the national interests. Sulphuric acid manufacturers are being compelled to roast copper pyrites and either themselves produce copper sulphate or supply copper sulphate works with the necessary copper. Generally, the policy is to replace pyrites exports by sulphur exports.

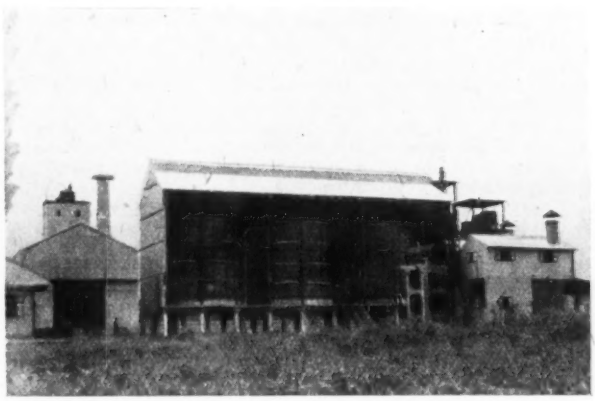

Fig. 5. Gaillard-Parrish sulphuric acid liquid phase plant. Nitric acid plant on right; pot acid concentrator plant on left

Marcasite, or coal brasses—an indigenous material—is now being used for the manufacture of sulphuric acid, and it is hoped that its use for this purpose will extend.

A note on the pyrites content of Brazilian coal and its utilisation in the manufacture of sulphuric acid and the preparation of elementary sulphur is contributed by J. O. de A. Doria.[11] Pyrites free from arsenic is said to be obtainable by simple washing, and a process for the manufacture of sulphur by reduction of sulphur dioxide with carbon at 1000-1150° C. is described. Several improved methods are claimed for the recovery of sulphuric acid from petroleum refining sludge. A. Glaser[12] adds the acid at a controlled rate to a suspension of bauxite in 10 per cent. alum solution. The precipitated SiO_2 adsorbs the organic matter in the acid, which, after filtration, is evaporated to remove the Fe as $FeSO_4H_2O$, and subsequently cooled to recover alum or $Al_2(SO_4)_3 18H_2O$. For the recovery of sulphur as such, B. M. Carter[13] subjects the acid sludge to thermal decomposition and after preheating the resulting gases effects their decomposition by passage over hot coke at controlled temperature. The products of the reduction are then passed through a preheater and finally through a condenser to collect the sulphur.

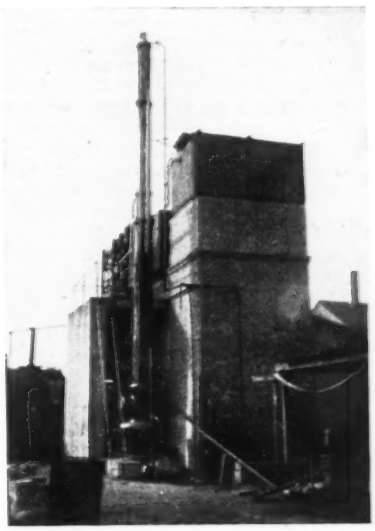

Fig. 6. Improvised concentrated gas-liquor plant

Sulphuric Acid

The Gaillard-Parrish liquid phase system continues to extend, and the plant shown in Fig. 5 represents a small unit erected in Thailand, at the Government factory. This plant has served to demonstrate that the liquid phase system of sulphuric acid manufacture is as effective in small units as it is in large plants. The kinetics of absorption processes, particularly in relation to the testing and efficacy of the packing of Gay-Lussac towers, have been examined by Kusminich, Juschanov and Apachov.[14]

New patents dealing with the contact process have not been so numerous as in the past few years. Carl[15] proposes a system of heat exchangers to utilise the heat from the sulphur trioxide issuing from the converter, while Ferguson[16] describes the construction of a multi-stage converter in which the gases are cooled between each stage by admixture with air introduced by a number of Venturi jets.

The methods available in industry for the removal of

acid mists are divisible into three groups, viz. (1) packed scrubbers, (2) centrifugal separators and (3) electrostatic precipitators. The principles underlying each of these types and the factors controlling their efficiency are discussed by G. L. Fairs,[17] who also deals generally with the stability of acid mists. The Bamag plant has been described.[18] This is a variation of the pot-dephlegmator concentrator in which there is no mechanical agitation. A novel method of concentration is due to Kalous.[19] Apparatus is described in which the acid is passed counter-current to superheated steam, this being the only source of heat provided in the concentrator proper. A proportion of steam, equivalent to the water evaporated, is removed from the circuit and the remaining steam reheated and used again. By using steam in place of hot combustion gases as the heating medium, many of the disadvantages of the hot-gas method of concentration are removed.

Ammonia and Ammonium Salts

Many improvised plants for the manufacture of concentrated gas liquor, 15-16 per cent., of the Parrish type have been erected, and the production of concentrated gas liquor has sensibly increased. Fig. 6 shows an improvised concentrated gas liquor plant designed to produce a 20 per cent. NH_3 product. This unit embraces a continuous pump feed, controlled by an Arca regulator. The still head temperature governs the gas liquor feed and ensures a constant still head temperature. The still consists of a ring-packed column, but experience has revealed that increased efficiency can be obtained by the introduction of three or four distributors, placed at suitable intervals. There is a tendency for the gas liquor undergoing distillation to migrate to the sides of the column still, and the distributors serve the purpose of ensuring re-distribution over the packing. Failing the provision in question it is desirable to adopt a parallel flow packing. The Arca controls in connection with this plant are shown in Fig. 7.

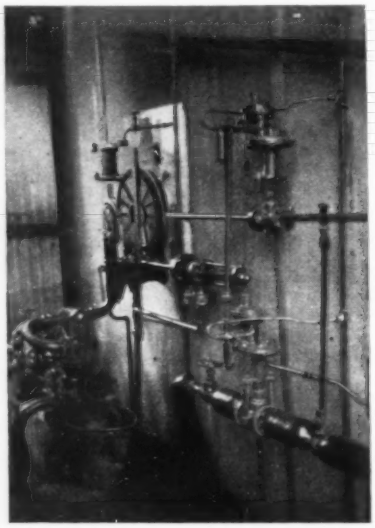

Fig. 7. Arca controls in connection with improvised concentrated gas liquor plant

Home prices for sulphate of ammonia are fixed on the basis obtaining for 1940. These prices represent an increase of 48s. per ton over the corresponding price for 1939. Manufacturing costs continue to increase, because charges for fuel, labour, and repairs and maintenance materials have progressively advanced.

Development of apparatus for ammonia synthesis is claimed by Wedard.[20] The reacting gases are passed into a vessel containing liquid NH_3 at a pressure above 50 atm. and at suitable temperature. The gases contain the catalyst in suspension and the gases are previously activated by physical means. The effect of the alumina content of iron catalysts on their activity at atmospheric pressure has been investigated by a group of Russian workers.[21] The use of cracked or burnt NH_3 for the treatment of metals offers definite economic and practical advantage over cylinder gases under certain conditions. A comprehensive review of this subject is contributed by Brandt.[22]

The production of aqueous ammonia of high concentration from dilute solutions is dealt with by Bennett.[23] The dilute solution is passed down a tower in counter-current to steam at not less than 82 lb./sq. in. By simple condensation under pressure of the steam and ammonia leaving the dissociator a product containing upwards of 58 per cent. of ammonia is obtained. In the manufacture of ammonium chloride, particularly if the product is to be used for hot galvanising, the crystal characteristics of the product are of no little importance. Heimbach[24] adds small amounts of $CaCl_2$ and $(NH_4)_2HPO_4$ to the hot concentrated solution to form nuclei of $CaNH_4PO_4$, about which the ammonium chloride forms dense glossy crystals on cooling.

Alkali Industry

There is little to record about the alkali industry. The ammonia-soda and electrolytic processes are working as hitherto, and the demand for chlorine largely determines which process is pursued. New plants have been erected, but these, apparently, have been designed on the basis of established practice. Large quantities of lime are used in the ammonia-soda process, and manufacturers have had to contend with such difficulties as interrupted fuel supplies and the necessity for operating their lime kilns under black-out conditions. The quality of lime produced has obviously suffered. The treatment of magnesia-containing limestones (dolomite) for the recovery of MgO has increased the production of calcium carbonate and lime, while several hitherto waste lime products are now being treated and rendered suitable for agricultural purposes.

Fertilisers

Phosphatic.—With the extension of hostilities to the Far East, the problem of the supply and distribution of phosphatic fertilisers and the raw materials for manufacture becomes increasingly acute. Important changes in the form of product and methods of manufacture would appear imminent, as regards phosphatic fertilisers. It may well be that the use of metaphosphates of calcium and potassium will increase in the near future. One method of producing calcium metaphosphates consists in burning phosphorus and bringing the products of combustion into contact with lump rock phosphate packed in a vertical shaft.

A method of admitting of the direct production of superphosphate, normally yielding a 15-17 per cent. product, is described by A.-B. Kemiska Patenter.[25] The process consists essentially in mixing the total sulphuric acid required for decomposition with only part of the raw phosphate, separating the calcium sulphate and insoluble residue, and using the $H_2SO_4-H_3PO_4$ to react with the remainder of the raw phosphate. Mixing proportions are given for systematic filtration conditions.

During the year some superphosphate works in this country have had to use phosphate from Curaçao, and the hardness of this raw phosphate has caused loss of throughput, because the quantity capable of being ground to predetermined size has been sensibly less than with normally-employed phosphate rocks. Pelleted fertilisers have likewise evoked interest. By extrusion of the product through mill dies, and cutting, pellets are formed into suitable lengths. The method is said to be applicable to nearly all single fertilisers, and fertiliser mixtures, mineral or organic. Pellets of superphosphate 3/16 in. in diameter and cut to the same length, have been drilled into soil with barley seed, with excellent results. Additional advantages are (a) reduction of leaching loss and (b) greater efficiency of utilisation.

B.P. 535,470, of 1939 (Silesia Verein Chem. Fabr.), subjects a superphosphate to a plasticising treatment by edge runners, extrusion presses or similar plant, and afterwards treating the plasticised material to the simultaneous application of movement and heat in heated rotating apparatus. The hardness produced in the granules is ascribed to

(*Continued on page* 27.)

Solvents and Plasticisers in War Time

By
ARTHUR M. PEAKE

DURING the period under review the principal problems in the solvent and plasticiser fields have been the needs of speeding up and increasing the production of compounds essential to the war effort, of finding substitutes for these materials for use in the "non-priority" industries, and of guarding against the risks involved in the handling of large amounts of compounds, most of which are to some extent toxic to those handling them, as well as often being highly inflammable. For obvious reasons many developments in those industries conected with supplies for war purposes have been kept secret, and none of the new compounds suggested as solvents or plasticisers, on which any reliable information has been published, seems of such outstanding merit as to call for mention outside the group to which it properly belongs. Several interesting articles have appeared which deal with methods for avoiding fire risks, and one of the most important of these is undoubtedly the very comprehensive table drawn up by the Associated Factory Mutual Fire Insurance Companies, U.S.A. (*Ind. Eng. Chem.* 1940, *32*, 880) which gives the flash point, explosive limits, auto-ignition temperature, susceptibility to spontaneous heating, specific gravity, vapour density, melting point and boiling point for practically every inflammable compound used industrially, together with information on the most suitable extinguishing agents in each case. From the U.S.A. also comes the description of how an acetate rayon plant assures protection against fire (*Morgan, Chem. Met. Eng.* 1940, *47*, 403). Specially hazardous locations are protected by carbon dioxide piped to twelve of the process spaces and automatically controlled by an ingenious electro-mechanical system; a manually controlled carbon dioxide system, hand extinguishers and sprinklers are also used.

Toxicity of Solvents

In the literature on this side of the Atlantic, reference can be made to a comprehensive survey of modern methods of fire extinguishing (Jones, *Chem. and Ind.*, 1941, *60*, 113). Russia has contributed the results of investigations of the explosive limits of ethyl alcohol-ether mixtures in air under various conditions (N. Pashai, *J. Appl. Chem. Russ.*, 1930, *12*, 720; *B.C.A.B.*1, 1940, *59*, 19), and Germany has reported the results of a methyl chloride-air explosion. The explosive limits of an air-methyl chloride mixture are said to lie between 8.9 and 15.5 per cent. methyl chloride. There have been a number of references in the literature to the toxicity of solvents, particularly of the chlorinated aliphatic hydrocarbons, but for the most part these only confirm what was already known, and contribute little to the sum of new knowledge. As might be expected, the nitroparaffins are toxic and require care in handling, but some of their derivatives, probably owing to lower volatility, seem relatively harmless. Claims have also been made that dibutyl phthalate is practically non-toxic, whereas other plasticisers such as dimethyl phthalate, tributyl phosphate, etc., have a distinctly toxic action, but it is probably correct to say that no solvent nor plasticiser is entirely without some injurious effect on workers exposed to it.

The aliphatic alcohols play an important part in the solvent and plasticiser fields, as many of them have valuable solvent properties themselves, and all of them can serve as the starting point in the production of derivatives which may be useful as solvents or plasticisers.

There is little to report on developments in the production of methanol, although it is possible that increased demand due to the war has helped the wood distillation industry everywhere. An article in the *Industrial Chemist* (February, 1940) shows that even in this country wood carbonisation is still holding its own. The works described, "somewhere in the West of England," produce a range of solvents from wood distillation. Russian workers have claimed that methyl alcohol can be obtained in good yield by passing a mixture of carbon dioxide and hydrogen over a chrome-zinc nickel catalyst at 370° C. The gas mixture is obtained as a by-product in the butyl alcohol-acetone fermentation, and must be freed from sulphur compounds by treatment with active carbon before use to prevent inactivation of the catalyst.

The Quest for Alcohols

The need for more and yet more ethyl alcohol for industrial purposes, and particularly as a substitute for petrol in motor fuels, has led to investigations in many places on the potentialities of new raw materials as a source of production. Important among these is sweet millet (*Sorghum saccharatum*) from which Italy now obtains an appreciable proportion of her alcohol supplies. This, of course, could not be grown here, but seems of interest in many of the Colonies having a sub-tropical climate. It would appear that some experimental work on the cultivation of the plant has already been carried out in Queensland. Extensive investigations on the cultivation and utilisation of sweet millet has been made in Italy in the past few years, and from reliable information received just before the outbreak of war with that country, it appears that many important distilleries are operating with it as sole raw material. Both the sugar-containing juice and the grain heads can be used as a source of alcohol, or the latter can serve in place of maize for the production of butyl alcohol and acetone. The possibility of using sorghum for the manufacture of alcohol is attracting attention in France also. An article by E. Miege (*Comptes Rendus Acad. Agric.*, 1940, *26*, 179, and *Chem. Abs.*; 1940, *34*, 3429) confirms the results of Italian workers that the sugar content of sweet millet stalks increase with maturity and draws the conclusion that this plant is capable of furnishing alcohol of good quality on an industrial scale.

There is reason to believe that Germany is obtaining alcohol from horse chestnuts by the process described in G.P. 681,163 (Kastanien Werke). In this method the toxic action of the saponins on yeast, which was formerly an obstacle to fermentation, is prevented by the addition of from 0.7 to 1.0 per cent. of a higher alcohol such as butyl or amyl alcohol or of a polyhydric alcohol such as ethylene glycol or glycerol to the mash. The higher alcohol accumulates subsequently in the fusel oil and can be recovered and use again. Among other new materials suggested for the manufacture of alcohol reference can be made to acorns, vine branches, and *Polymnia edulis*. This last is a plant producing tubers and seems closely related to the *Helianthus* group, although it contains less fructose.

Side by side with the search for new raw materials, efforts have doubtless been made to increase the yields of alcohol obtained in the usual methods of manufacture by improving fermentation efficiencies and reducing distillation losses, but none of the results obtained have been published in any of the countries involved in the war. As regards synthetic ethyl alcohol, the most recent figures published by the U.S. Revenue Department show that more than 25 per cent. of the ethyl alcohol produced in the U.S.A. is obtained from ethylene, and it would appear that considerable progress has also been made in Russia in the hydration of olefines on an industrial scale. No information is available on developments elsewhere. A number of patents covering processes in this field have been published, but none of them show any outstanding feature of interest, and for the most part they describe minor modifications of well-known acid-absorption or liquid phase acid hydration processes.

A chemist of the Japanese Ministry of Finance is reported to have perfected a method for producing anhydrous

ethyl alcohol from acetylene, using copper, cobalt, and nickel as catalysts.

A somewhat unusual suggestion for the use of industrial alcohol as an extraction solvent has been made in India. Industrial alcohol is said to be an excellent extracting medium for castor oil, and the production of cheap industrial alcohol from molasses in India would render the project commercially profitable. Literature about the propyl alcohols has been very scanty. Katuno (*J. Soc. Ind. Japan*, 1940, *43*, 5; *Chem. Abs.*, 1940, *34*, 1831) has investigated the synthesis of isopropyl alcohol from propylene and has confirmed the superiority of the so-called "sulphation" method which has for some time been extensively used in the U.S.A.

Fermentation Problems

As might be expected with the increased demand for acetone, there has been a "certain liveliness" in investigations on the butyl alcohol-acetone fermentation process, and several materials which hitherto have not been utilised industrially have been suggested as sources of the solvents in question, including Jerusalem artichokes, waste sulphate liquors from pulp mills, and sweet potato. There seems little doubt, however, that for a long time to come molasses, and to a less extent maize and cassava, will remain the principal sources of fermentation for butyl alcohol and acetone. The so-called Weizmann organism which operated successfully on starchy mashes has always given erratic results with sugar solutions. From literature published recently it is evident that attempts are still being made, particularly in Russia and Japan, to produce new strains or to acclimatise existing strains of the organism with the purpose of obtaining consistently successful results from molasses. These efforts seem wasted as there are now several other organisms known which can be and are being used industrially for the fermentation of molasses mashes and other sugar-containing solutions. Descriptions of two attempts to improve fermentation technique have come to us also from Russia—in one of these castor oil is used for the continuous extraction of the neutral products during fermentation, and in the other a battery of seven fermenting vessels in series is used. No information is available on any developments in the manufacture of synthetic butyl alcohol, and the literature published on the subject seems to consist almost entirely of patent specifications of little importance.

The problem of increasing the yield of fusel oil has attracted attention both in Russia and in Japan, and the attempts to solve it by modifying conditions of fermentation, particularly by the addition of various amino-acids, although they have given some results of scientific interest, do not seem to have met with much success industrially.

Octyl alcohol is now produced and marketed in bulk in the U.S.A. as it has been found to possess valuable solvent properties for alkyds and urea resins in addition to its known uses as an anti-foam and penetrating agent.

The most interesting development in glycol chemistry in recent years is the attempt to industrialise the direct oxidation of ethylene to ethylene oxide—one of the most important basic materials in the production of glycols and their derivatives. Judging from the number of patents issued, for the most part based on the discovery made by J. Francon some years ago that, given certain conditions, silver is a specific catalyst for the reaction, it is evident that a considerable amount of work is still going on in this direction both in this country and elsewhere. It is impossible to say, of course, how far the claims in the patents issued reflect actual industrial development, but there is reason to believe that considerable progress has been made towards a satisfactory solution of the problem. The use of hexamine as a catalyst for the production of glycols and their derivatives from alkylene oxides (B.P. 530,230) appears an interesting development, but otherwise there seems little worthy of mention as regards the glycols.

Among the polyhydric alcohols, glycerol and pentaerythritol are of paramount importance at present and this is reflected in the number of articles and patent specifications relating to them which have been published in the last two years. Although many of these present features of interest it would be impossible to deal with them in detail. It is certain, moreover, that the results of many of the investigations have been kept secret for obvious reasons. Until the war clouds became threatening, foreshadowing a greatly increased demand for glycerol, there was little industrial incentive to investigate alternative sources of supply, as the supplies available from the soap industry were abundant and relatively cheap. The imminence of war, however, made it advisable everywhere and obligatory in some countries to bring alternative methods of manufacture to the production stage. An intensive study to improve the fermentation process already used in Germany during the war of 1914-18 has been carried out during the past few years in Germany and Italy. According to reports from the latter country the entire requirements of glycerol for explosives are now met by glycerol produced from molasses. The principal difficulty in the fermentation process has always been the recovery of pure glycerine from the crude wash and numerous suggestions have been put forward to deal with this. These include the extraction of the glycerol by solvents, chemical treatment to remove impurities hindering distillation, and special methods of distillation. Even before the war the Italians claimed that they had worked out a new and effective process of recovery, but no reliable information is available on the actual methods adopted. Some work has been carried out there and in the U.S.A. on the production of glycerol by the catalytic hydrogenation of sugars, and although the Bombrini Parodi-Delfino concern, propably the most important Italian firm manufacturing explosives, acquired rights in a patented process which described modified operating conditions whereby the proportion of glycerol produced could be increased, it is very doubtful whether any hydrogenation method of production has reached the industrial stage anywhere.

Glycerol Synthesis

More progress has been made in the U.S.A. in the synthesis of glycerol from propylene by first forming allyl chloride by a high temperature reaction and chlorhydrination of the allyl chloride with subsequent hydrolysis (*see* THE CHEMICAL AGE, 1941, *44*, 110). This process had already reached the semi-commercial scale more than a year ago after many difficulties had been overcome. The properties and potential uses of the intermediates formed in the synthesis have been investigated and it may well be that some of them will find industrial application after the war.

Numerous patent specifications on the manufacture of pentaerythritol have appeared, but for the most part these only describe what appear to be unimportant modifications of known processes. U.S.P. 2,223,421 (Niacet Chemicals Corporation), however, covers an ingenious and probably very useful method for recovering pure pentaerythritol from the crude reaction mixture by separation as an acetal. It is very improbable that any surplus pentaerythritol will be available during the war, but it is evident that investigations are going on in Germany as well as here and in the U.S.A. to find industrial applications for the compound and its derivatives when the present trouble is over. Both Crebert (*Fette und Seifen*, 1939, *46*, 287), and Ostwald (*Paint Varnish Production Manufacturer*, 1941, *21*, 102) conclude that esters of pentaerythritol with the resin acids may be very useful in the production of paints and varnishes.

There is little to report on the manufacture and applications of ketones. For the synthesis of acetone from acetylene it is claimed by Korzhina (*J. Appl. Chem. Russ.*, 1940, *13*, 1014; *Chem. Abs.*, 1941, *35*, 2111) that zinc-vanadium and zinc-columbium catalysts have much higher activity and stability than those usually employed. Attempts by Russian workers to improve the efficiency of ethyl alcohol-acetone fermentation processes and to increase the yield of acetone do not seem to have been very successful. Reports have reached this country that Japan has started the manufacture of synthetic acetone from acetylene. Hitherto, except for small amounts produced

by fermentation, Japan has been dependent on the U.S.A. for her acetone supplies. An interesting paper by Langedijk (*Chimie Peintures,* 1940, *3,* 40) deals with the value of methyl ethyl ketone as a solvent for nitrocellulose, cellulose acetate, and resins.

Isophorone, a stable cyclic ketone which has recently become available in the U.S.A., promises to be a valuable addition to the ketone group of solvents. It has a relatively high boiling point of 215° C. and in addition to being a solvent for nitrocellulose, resins, oils, gums, and basic dyes, it has a powerful solvent action on "Vinylite" resins.

Although there have been many references in the literature to the manufacture and application of esters, there is little to indicate that any striking developments have taken place. The Russians apparently are still working hard in their attempts to produce esters from alcohols by high temperature catalytic action, but the industrial value of any process of this nature seems doubtful except under special circumstances, such as for example, the non-availability of the acids required for the normal esterification methods. The production of esters from olefines by direct combination with carboxylic acids seems a much more attractive proposition and considerable progress has been made towards putting this method on an industrial basis. Among the numerous catalysts proposed and for the most part protected by patents, acid manganese phosphate and boron trifluoride seem to be the most effective in promoting the reaction in the vapour phase.

It is reported that ethyl acetate is now being manufactured in Canada by the condensation of two molecules of acetaldehyde in the presence of aluminium ethylate. This type of condensation has been known for some years and many proposals have been made and patented to utilise it for the production of esters, but, within the author's knowledge, it has not been previously used on an industrial scale to any significant extent.

Solvent Esters

Claims have been made by American workers for the superiority of isobutyl acetate and isobutyl propionates as lacquer solvents, but as far as one can judge, these esters seem to differ very little in their behaviour from the corresponding normal compounds. Considerable attention has also been given in the U.S.A. to derivatives of lactic acid, and a very interesting article by Smith and Claborn (*Ind. Eng. Chem.*, 1940, *32,* 692) on the preparation and properties of a large number of lactic esters is worthy of mention. Other work has shown that the lactic esters, particularly ethyl lactate, possess greater stability than was hitherto supposed. The large scale production of the nitroparaffins which has occurred in recent years has opened a new chapter in the development of the synthetic organic chemical industry and a study of their derivatives which has already been started in the U.S.A. will undoubtedly lead in due course to the discovery of many compounds of industrial value. The condensation of the nitroparaffins with aldehydes produces nitro-alcohols which in turn can be reduced to the corresponding amino-alcohols. Many of these alcohols and their esters have already been prepared and studied and to those interested in the subject the original articles by Vanderbilt and Hass (*Ind. Eng. Chem.*, 1940, *32,* 34) and by Tindall (*Ind. Eng. Chem.*, 1941, *33,* 65) are well worth perusal. As regards the nitroparaffins themselves, B.P. 527,031 (I.C.I.) describes a method of manufacture from nitrogen peroxide in paraffins in the gaseous phase, using a silicate glass containing arsenic or antimony as catalyst, and U.S.P. 2,233,620 (Commercial Solvents) claims that the thermal stability of the compounds can be improved by the addition of small amounts of boric acid or its derivatives.

There seem to have been no important developments as regards the usual hydrocarbons and halogenated hydrocarbons, but in the miscellaneous group a brief reference may be made to a furfural derivative "Sylvan," 2-methylfuran, which is said to possess valuable solvent properties.

A number of interesting articles have appeared, particularly in American journals, dealing with solvent recovery, solvent extraction processes, and the physical and chemical properties of solvents. Physical properties and constants of a large number of solvents and solvent mixtures have been also given in the chemical journals, particularly in the journal of the American Chemical Society.

Plasticisers for Polymers

Most of the investigations in the plasticiser field seem to have been directed to a search for useful plasticisers for polymers such as polyvinyl chloride, polyvinyl acetals, polystyrene, and so on, but little information is available on the results except that contained in the stream of patent specifications that issues with unfailing regularity from the different patent offices of the world, particularly from that of the U.S.A. A paraphrase of the well-known ironical description of the habits of the British—"It is a fine day, let us go out and kill something,"—that could be applied to some American firms would be—"It is a fine day, let us go out and file a patent application for a plasticised organic composition." It is probable moreover that the result of most of the work carried out has not been disclosed, as the synthetics play an important part in wartime economy, and it is very difficult, therefore, to assess the value of the most of the compounds claimed to be good plasticisers for this or that synthetic resin or to give any reliable opinion on the extent to which they are used industrially. Speaking generally, it seems safe to say that most of the plasticisers that have been found successful in treating cellulose esters, for example, tributyrin, alkyl stearates, esters of phthalic and citric acids, etc., can be used equally well with polyvinyl acetals and polymerised esters, such as the methacrylates, whereas for polystyrene, polyvinyl chloride, and the like, plasticisers from the hydrocarbon and halogenated hydrocarbon groups are more suitable. There are, of course, exceptions to this general rule, as butyl stearate, one of the most widely known of the plasticisers for nitrocellulose, is a useful addition to some types of polystyrene and polyvinyl chloride compositions, and chlorinated diphenyls seem to be a useful plasticiser for cellulose acetate and cellulose aceto-butyrates. Two new compounds which have become available commercially in the U.S.A. under the trade names of "Hercolyn" and "Abalyn" seem to possess useful properties as solvents, plasticisers and penetrants. The former is methyl abietate which has been hydrogenated for stability, while the latter is straight methyl abietate which is reactive and can be oxidised.

Acetyl triethyl citrate and acetyl tributyl citrate are now available at prices which render them of interest. These esters have much the same plasticising properties as the non-acetylated compounds and are in addition much lower in volatility and sensibility to water. Both seem to be of particular interest as plasticisers for cellulose acetate. On the Continent much attention seems to have been given to the use of the crotonic esters of polyhydric alcohols such as glycol dicrotonate and pentaerythritol crotonate, as plasticisers for nitrocellulose, but any advantages these compounds possess, unless they are very specific, would seem to be outweighed by high cost of production and probable instability. According to articles in the German Press, dichloroethyl phosphate "Cetamoll QU" is one of the best plasticisers for nitrocellulose, as in addition to imparting flexibility, it has definite value in reducing inflammability. As regards plasticisers in general reference can be made to the series of articles by Kraus in *Farbe und Lack*, abstracts of which have appeared in *Paint Technology* and elsewhere, which deal very exhaustively with plasticisers for nitrocellulose, and to an article by Fordyce and Meyer (*Ind. Eng. Chem.*, 1940, *32,* 1053) on plasticisers for cellulose acetate, cellulose acetobutyrate, etc.

CLOTHING FOR ACIDS AND ALKALIS

As a rule clothing for workers with acids, apart from special items such as rubber gloves, should be made of wool and not cotton, since acid solutions readily attack cotton textiles. Conversely, alkali-workers should wear cotton rather than woollen clothing, because wool is readily attacked by alkali. *Industrial Accident Prevention Bulletin* (1941, *9,* 102, p. 80).

PLASTICS IN 1941

By

HARRY BARRON, Ph.D., B.Sc., A.I.C., A.I.R.I.

I THINK the outstanding feature of plastics during 1941 has been the complete disappearance of *laissez faire*. While fairly rigid controls existed in belligerent countries, one has always regarded the United States as a sort of plastics paradise, where plastics production could take any direction, functional or decorative, useful or useless. During the year, however, the brake was gradually but firmly applied there. Plastics production came under the direction of the Office of Production Management, and has been orientated towards production for the Services, as in other countries. Shortages became apparent, and these have had repercussions on our own activities. It is interesting to consider the reasons given, these being summarised as: (1) delay in delivery of presses; (2) non-availability of skilled mould makers; (3) rationing of nickel steel needed for moulds; and (4) limited equipment capacity for making plastics and their raw materials. Of these the fourth was the most serious difficulty. There is already a marked absence of gadgets, novelties, and decorative items.

All this applied before the United States entered the war. We have already felt the effects because our thermoplastic industry depends on U.S. raw materials. Shortage of supply coupled with the exigencies of transport has inevitably led to a tightening up of our own control. This past year has emphasised the disgraceful folly and lack of vision that has left us without internal sources for production of these thermoplastics. It is true to say, however, that small scale production of some of these materials, such as polystyrene, polyvinyl chloride, etc., has made progress.

One very noticeable feature in this country has been the growing awareness of plastics. The shortage of metals has opened up many new outlets which have been duly observed by the public. There has been a belated realisation of the numerous merits of plastics which has become evident in every aspect of public expression. There have been talks by the B.B.C., while almost every speaker in the "Brains Trust" has referred very knowingly to plastics at one time or another. The Press, too, has become much better informed on the subject. These are definite signs of progress. Probably much of the credit for this awakening must go to Dr. Yarsley and Mr. Couzens for their excellent little book "Plastics," which, published as a *Pelican* book, has had an enormous circulation.

As usual, available statistics are American, and apply for 1940. This was before any efforts related to the war had been made. Every type of plastic except nitrocellulose made notable gains. Nitrocellulose was well down on the previous year, with 12 million lb. produced; on the other hand, cellulose acetate was 28 per cent. up at 24 million lb. The total application of phenolic resins, for moulding, laminating, adhesives, etc., was 81 million lb., this being an increase of 36 per cent. on 1939. Urea resins reached a new high figure at 21½ million lb. Apart from the cellulose plastics, thermoplastics generally made great progress. Polyvinyl plastics were going great guns. The safety glass material, polyvinyl butyral, registered 5 million lb. during the year. While no figure was given for polyvinyl chloride and copolymer resins, the amount was considerable; incidentally, the 1941 amount was estimated to be 15 million lb. Acrylic resins were used to the extent of 3 million lb., while polystyrene was at 1½ million lb. Vinylidene chloride plastics were well under way and were expected to reach high figures during 1941. Phthalic resins reached the remarkable level of 91½ million lb., while resins based on maleic anhydride were at 6½ million lb.

With the United States making a pronounced war effort the quantities used during 1941 were expected to reach astonishing levels. So far as our own production is concerned it seems probable that there were pronounced increases in the quantities of phenolic and urea resins. But in the thermoplastic class, apart from cellulose plastics, we continue to stagnate. We have no programme comparable to the forecast U.S. production of 40 million lb. polyvinyl chloride plastics in 1942, and 30 million lb. polystyrene for 1943.

During the past year melamine resins have fully justified their early promise. In this country they have gained very wide popularity, for use mainly in stoving finishes. British Industrial Plastics, Ltd., have led the way. In the U.S. and in Germany these plastics are also extensively used for moulding and laminating. The advantages of this class of resin include the speed of hardening at high temperatures—they are the fastest thermosetting resins, while colour and gloss are unaffected even when water-white. Equally valuable is the fact that they can be baked at relatively low temperatures, *e.g.*, 82° C., to give hard water-resisting finishes. These finishes are used on such things as stove parts, electrical equipment, refrigerator panels, etc. In moulding properties under heat and

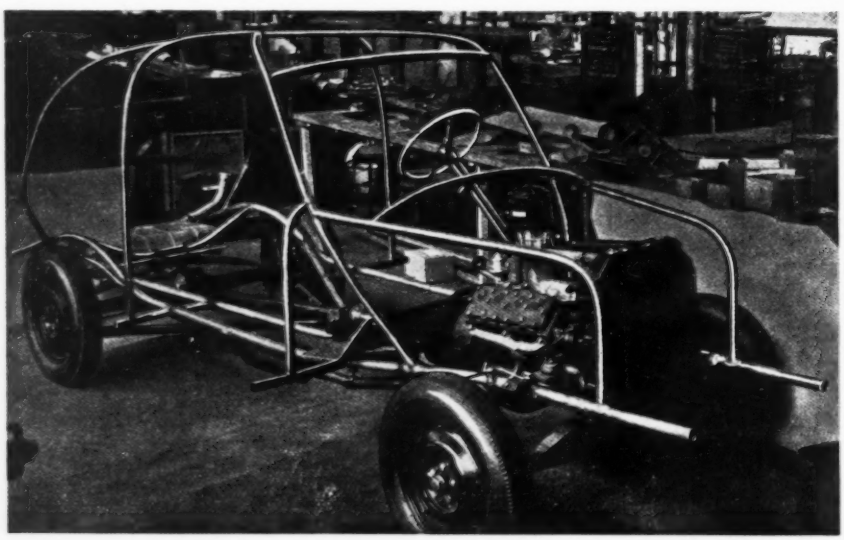

Fig. 1. The frame of the new plastic car. The plastic panels are clamped on to welded tubes of revolutionary design

(From PLASTICS)

pressure they resemble urea resins. They are, however, more heat-resistant, more inert, and harder. In the U.S. they are derived from carbide via cyanamide.

For a number of years Henry Ford has been endeavouring to make a motor car substantially out of plastics. His object has been to harness motor manufacture to his agricultural interests (soya bean cultivation, etc.) from which he derives his plastics. "We will make the entire superstructure of an automobile, except the tubular welded steel frame, of fibre plastic," he said, and during the year this has been realised. The entire car body is built of plastic panels. These are made from a mixture of synthetic resin and cellulose fibre. The plastic composition is mixed as a pulp, roughly formed into shape, and then pressed under heat and pressure along conventional lines. Quarter-inch panels have ten times the impact strength of the normal steel panels. There is about 33⅓ per cent. reduction in weight compared with the corresponding steel car. Another outstanding feature is that windows and windscreen are made from acrylic plastics. Mr. Ford has asserted that large scale production was planned for 1943, and it remains to be seen how American entry into the war delays that objective. Apparently he is satisfied that this car can compete on price with steel cars—and he should know.

During 1941 there has been a noticeable interest in the possibility of prefabricated dwellings, based on plastics, particularly among architects. Doubtless this has been stimulated by the destruction wrought during air raids, and the urgent necessity for replacements. Although this trend is well under way in the United States, it has not previously been seriously considered here. However, the advantages of mass production coupled with the excellent properties of the products have now become apparent. The preparation of large sheets bonded with phenolic resins presents no difficulties. Certainly, panels that are strong enough for a car will be quite strong enough for building purposes. The widespread use of these is already envisaged for indoor and outdoor use; the latter is attractive because ageing and weathering properties are excellent. The use of laminated materials for interior decoration is, of course, well-known, but these ideas go far beyond such luxury applications. Even structural sections such as beams, stanchions, angles, etc., are envisaged. The use of extruded thermoplastic and thermosetting sections, available in unlimited lengths, for such purposes as picture rails, dadoes, skirtings, etc., has become commonplace.

Bearing a very close relationship to these developments is the astonishing advance in the continuous extrusion of thermoplastics. This has become a major outlet for thermoplastics in the United States, and although not so well developed here, it has made notable progress during the year. The material is heated rapidly and forced in a steady stream through a die set in a screw type extruding machine. It is led on to a conveyor, and is coiled or cut into suitable lengths. No other finishing is necessary. Many cross-sections, round, flat, and fancy, may be made in varying thicknesses. The products are used for furniture, wall trimmings, and general decorative purposes. Thermoplastics such as vinylidene chloride and cellulose acetobutyrate are extruded into straw-like products of unequalled strength and durability which are cut to size and used for making woven furniture, etc. Corresponding to this, the extrusion of plastic insulation on to wires and the production of plastic sleevings have expanded considerably during the year. Vinyl thermoplastics are most favoured in this form of manufacture.

There has been a great extension in the efforts to produce plastic-bonded plywood aircraft, particularly lightly-stressed aircraft such as trainers. There are now numerous firms working on one system or another in the United States. In this country there is evidence that we also continue to progress. We have produced strong structures for aircraft purposes, in the form of orientated fabric impregnated with thermosetting resins, set by means of heat and pressure. In line with these activities is the continuing activity in the manufacture and use of plywood bonded with thermosetting resins. Not only are phenolic and urea resins being used, but also application of melamine resins has been made by virtue of the very low temperatures required for processing them.

In a world where foodstuffs are rigidly rationed it seems ludicrous to hear that commercial plastics are being made from coffee. During the year, Cafelite has gone into large scale production in Brazil. The bean is ground, and treated with solvent to remove oil, caffeine, etc. The meal, mixed with water, and with an acid catalyst, is heated at 150° C. in an autoclave. Washed, neutralised and dried, the product is a thermosetting powder. This is thought to be a very complex material, having a cellulosic base, impregnated with furfural resins formed with proteins, tannins, etc. Cafelite is a moulding compound which can be set at 175° C. under pressures of 2½ tons per sq. inch. Production is already in hand and a capacity of 10,000 tons is aimed at (*see* THE CHEMICAL AGE, October 11, p. 197).

Nylon has made great progress. New plants have gone into operation in the United States to meet an insatiable demand. Production is already well advanced in this country, although the materials produced are earmarked for war purposes. An interesting lecture by Dr. G. S. Whitby enabled us to obtain a much closer insight into the properties and applications of these remarkable materials. Silk and fibres of every description are being made, the most notable applications being for parachute fabrics, bristles for brushes, threads for surgical sutures, etc. A much wider industrial application is envisaged, and nylon is already being used for insulation. The Germans appear to be making great progress in this field of polyamide resins, but they seem to be more concerned to develop materials for moulding and in general for use along conventional lines. The advantages over other

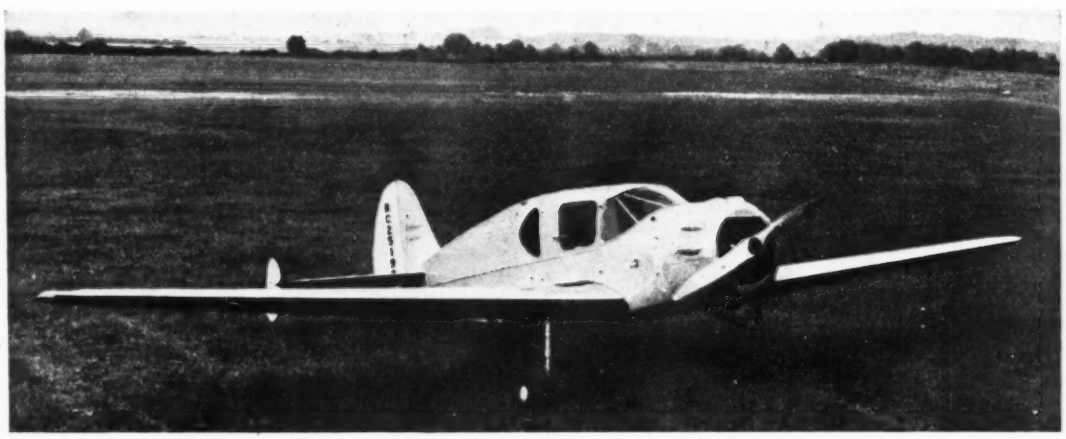

Fig. 2. Bellanca "Cruisair" much of which is constructed of wood plies bonded with a resin adhesive

(From PLASTICS)

thermoplastics are considerable. The resins have exceptional resistance to cold, down to -70° C., and very high softening points, up to 250° C., while they are unaffected by sunlight and are incombustible. They also resist most solvents. Drawn into threads they have tensile strength which may be as great as that of steel.

A novel method of moulding appeared during the year. British Thomson Houston, Ltd., mould articles by the use of hot steel shot. The object, wrapped with resin-impregnated strips protected by a rubber bag or sheet, is placed in a strong moulding box and is then surrounded with hot steel shot. The top of the box is closed with a thick metal plate which in effect becomes the plunger, transmitting the pressure from a hydraulic press to the shot. The fit need only be close enough for the passage of 0.040 inch shot.

In brief, the year under review has seen the continued transition from the application of plastics for decorative, non-essential uses over to strictly utilitarian purposes. The recent spread into heavier industries is particularly noticeable and significant. The barriers imposed by the impossibility of competing with cheap metals have now been virtually removed owing to scarcity of the latter. The result is that merits hitherto unrevealed have come to light, and an even wider and more stable basis for plastics in the future has been created. With the entry of the United States into the war, the whole weight of the greatest plastics industry in the world will be put into utilising plastics on a more functional basis. The beautiful decorative luxury articles will doubtless disappear for the time being. But the industrial developments should be startling.

SOME COLLOID-CHEMICAL NEWS OF THE YEAR

Studies of Emulsions and Detergents

by J. J. BIKERMAN

AN outstanding event in the history of colloid chemistry in this country in 1941 was the meeting of the Faraday Society dealing with the "oil-water interface." The boundary between water and liquid or semi-liquid organic substances immiscible with water determines the behaviour of a very large number of goods, from milk and butter to petroleum and transformer oil. Some of the papers presented to the meeting are of a more biological or a purely theoretical interest, but those by A. King (*Trans. Farad. Soc.*, *37*, p. 168) and R. C. Pink (*loc. cit.* p. 180) may give useful hints to the industrial chemist as well.

King differentiates between three or even four types of emulsion. To the first belong emulsions which contain no deliberately added or known stabiliser, and to the second those stabilised by electrolytes; neither is used in industry. Stable emulsions contain either a protective colloid of the type of saponin, gelatin, etc., or solid particles like those of bentonite or alumina. Sodium oleate when present in very low concentration acts as an electrolytic stabiliser, and at higher concentrations as a protective colloid; that is an example of the necessity of quantitative considerations in the chemistry of emulsions. The stability of emulsions is affected differently by various agents according to the type of stabiliser; unfortunately, the comparison is rendered difficult by the varying dispersion of emulsions of various types. Emulsions in which the "oil" has a density nearly identical with that of water are, as would be expected, more stable and easier to prepare than those showing a considerable difference in density between the oil and the water phase.

Pink compares the stability of water emulsions in benzene emulsified with various soaps of non-alkali metals. Magnesium oleate and magnesium stearate are the best emulsifiers, and nickel and zinc oleate the worst. When the benzene phase is separated by centrifuging it is found that it contains almost no soap in the cases of magnesium oleate and stearate and almost the whole amount of soap with nickel and zinc oleates. It appears that those soaps are the most efficient emulsifiers which are precipitated at the benzene-water boundary and form a solid protective layer in it.

Much the same ground is covered also by A. R. Martin and R. N. Hermann (*loc. cit*, pp. 25, 30). They find a difference in the behaviour of oils according to their interfacial tension against water. Liquids like aniline or chloroform possessing an interfacial tension below 42 dynes per cm. readily give oil-in-water emulsions when shaken with a dilute sodium oleate solution; but when the tension is high, as for carbon disulphide or hexane, a tendency is noticeable to form unstable water-in-oil emulsions. Copper chloride coagulates oil-in-water emulsions more rapidly than zinc sulphate or calcium chloride; this is correlated with properties of copper, zinc, or calcium oleates which are formed in an exchange with the sodium oleate emulsifier.

The quality of detergency is often related to the formation of emulsions. When wool soiled with olive oil is immersed in a soap solution, it can be seen under a microscope that the oil which has been evenly distributed in or on the hairs gathers into separate droplets which after a time leave the surface of wool and start floating in the liquid (R. C. Palmer, *J.S.C.I.*, *60*, 56, 60); the phenomenon may be described as desorption of an emulsion. It is well known that many salts increase the detergent action of soap and soap substitutes. Palmer investigates this effect on modern detergents of the type of sulphonated lorol or Igepon T. He finds that different sodium salts (chloride, sulphate, carbonate, and so on) intensify the action of a detergent most when they are present in 0.5 N to 1 N solution, while more concentrated solutions are ineffective. Bivalent cations either raise the detergent effect only at lower concentration (*e.g.*, magnesium chloride in a 0.005 N solution) or do not raise it at all (*e.g.*, barium chloride). A kind of "salting-out" effect would account for the increase of the detergent efficiency, but no explanation is advanced yet for the deterioration of the efficiency in concentrated salt solutions. In agreement with the old experiments of Reychler it was observed that the detergent effect of sulphonated oil was scarcely affected by a variation of the acidity of the solution.

Bacon, Hensley, Vaughn, and Vittone (*Ind. Eng. Chem.*, *33*, 723, 1011) made an extensive study of the laundering effect of sodium carbonate-sodium bicarbonate-soap mixtures. When the ratio of carbonates to soap increases at a constant pH, the detergency first increases and then falls off. Evidently the pH determined either potentiometrically or colorimetrically has no immediate effect on the detergent efficiency; alkali content measured by titration is a better guide. Instructive curves show the gradual decrease of the washing effect on gradual removal of dirt; it is much more difficult to remove from a cotton fabric the last 1 per cent. of soot than the first one. Indeed, roughly speaking, the washing of the first 90 per cent. takes only as much time as that of the next 9 per cent., or that of 0.9 per cent. after 99 per cent. had been removed. A list of nearly 300 commercially available wetting agents has been compiled by F. J. van Antwerpen (*Ind. Eng. Chem.*, *33*, 16), and another series, which is claimed to include the most powerful detergents known, is described by C. R. Caryl (*Ind. and Eng. Chem.*, *33*, 731). These are sulphosuccinic esters, *i.e.*, esters of the acid $HOOC.CH_2.CH(SO_3Na).COOH$. Esters of low-molecular

alcohols are not surface-active, but esters of 3-methyl-heptanol-6 or secondary octyl alcohol have this property to a high degree. Determination of the wetting power, discussed by F. E. Bartell (*Ind. Eng. Chem., 33,* 737), should include measurements of the influence of the wetting agent on the surface tension of water and organic liquids ("oils"), on the interfacial tension between oil and water, and on the contact angles water-air-solid, oil-air-solid, and water-oil-solid.

A review of contact angles and their measurement was presented to the Physical Society by A. Ferguson (*Proc. Phys. Soc., 63,* 554). Two new techniques were suggested by J. J. Bikerman (*Ind. Eng. Chem., Anal. Ed., 13,* 443) and A. E. Bate (*Proc. Phys. Soc., 63,* 403). They are mainly concerned with contact angles at the boundary of solid, water, and air. Bikerman measures the marks left by very small water drops on solid surface, and Bate compares the shape of very large air bubbles with that of very large water drops, both in contact with a solid.

Viscosity of Colloids

The resistance of colloid suspensions to flow often differs from that of ordinary liquids in so far as it cannot be attributed to an unchangeable viscosity. The complex or abnormal viscosity of colloids attracts so much attention that a Rheologists' Club was established in England to discuss its implications and study the "science of flow." The viscosity of aqueous emulsions of hydrocarbons and other "oils" depends on the kind and amount of emulsifier rather than on the nature of the oil, *e.g.*, emulsions stabilised by oleates are less viscous than those containing stearates, and those containing potassium stearate less viscous than emulsions stabilised by sodium stearate.

The rheology of clay is reviewed by H. H. Macey, of the British Refractories Research Association (*J. Sci. Inst. 18,* 159). Clay-water mixtures can be obtained in most varied forms, including quite fluid suspensions and "leather-hard bodies." The rheological properties of these mixtures determine their usage in pottery and play a considerable rôle in the water-binding capacity of soil. Their investigation, however, did not reach a stage of a few rules summarising the apparently complex behaviour. The position is still such that observations and measurements of one researcher cannot be correlated with those of another. Macey attempts to introduce some order into the confusion by postulating a repelling force between clay particles which keeps them separated by a water film.

G. W. Scott-Blair and F. M. V. Coppen (*J.S.C.I., 60,* 190) apply rheological analysis to butter, cheese, apple flesh, and other more or less familiar substances. The deformation produced by a constant stress increases at a constant rate for ordinary liquids, and at a variable rate for many semi-solid substances. The variation of the rate of deformation with time is the physical property most closely associated with "firmness" as used by craftsmen in judging cheese and similar products. An investigation of gunned asphalt on the same lines is published by D. C. Broome and L. Bilmes (*J.S.C.I., 60,* 184).

Measurement of Tackiness

That elusive property, "tackiness," an important characteristic of varnish, lacquer, printing-ink, etc., also appears to belong to the domain of rheology. H. Green (*Ind. Eng. Chem., Anal. Ed., 13,* 632) describes an instrument which permits the measurement of tackiness in a reproducible way and by definite units. He finds that among all the old-established physical properties, viscosity is the one here involved. When a varnish layer is spread over a solid surface it attaches itself to the latter so strongly that it is almost impossible to separate it again by any mechanical means. When one tries to lift the varnish layer by touching it with a finger and removing the finger, the varnish is deformed and starts to flow, and the resistance to flow produces the sensation of sticking. When a tacky liquid solidifies it usually gives an adhesive layer. All users of adhesive are familiar with the advice to put it on as thinly as possible. The rule justifying this advice is "the thinner the joint the higher its strength." Bikerman (*J.S.C.I., 60,* 23) attempts to account for this rule by probability considerations. Like any other piece of solid matter the adhesive layer breaks at its weakest spot; and the probability of a very weak spot being present is, naturally, the higher the larger the specimen, *i.e.*, in the case of adhesive joints, the thicker the joint.

Chromatographic Analysis

A colloid-chemical method of analysis invented by the Russian botanist Tsvett over 30 years ago has received, during the year under review, its first book treatment in English. The book is by L. Zechmeister and L. Cholnoky, the original edition was in German. Chromatographic analysis consists essentially in filtering a liquid mixture through a layer of an adsorbent which selectively extracts from the mixture various components, leaving other constituents unaffected. When some of the constituents are coloured and the mixture is filtered through a long column of adsorbent, the column after the adsorption is seen to consist of coloured horizontal layers. This chromatographic procedure can be employed not only for analysis of mixtures, but also for their separation. Tsvett was able thus to fractionate chlorophyll, and many other complicated substances have more recently been fractionated. It is quite probable that Tsvett's method would be helpful in many industrial separation problems; so far only a few patents are mentioned in Zechmeister and Cholnoky's volume.

(*Continued from page* 20.)

the consolidation of the material induced by mechanical treatment, reduced the amount of hollow space, which normally amounts to 50 per cent. in superphosphate.

Potash.—This country has been short of potash supplies during the year, and salt has been recommended as a displacing medium for such potash as the soils may contain. The output of potash in the U.S.A. has increased considerably during the last two years, and it is believed that figures will show a production for 1941 of over 750,000 short tons.

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Owing to the shortage of paper supplies, the practice of sending receipts for payments made by cheque is likely to be widely discontinued. Many more business houses will now have a form of receipt printed on the backs of their cheques, and recipients will acknowledge payment simply by endorsement. That is one way in which paper will be saved—can you find ways and means to save still more? Remember—paper paves the road to victory!

NEWS EVENTS OF 1941

JANUARY

AMONG the list of New Year Honours was the award of the O.B.E. to Mr. R. Murdin Drake, Secretary of the Association of British Chemical Manufacturers. Dr. S. S. Bhatnagar, O.B.E., D.Sc., at one time Director of Lahore University Chemical Laboratories, was created a Knight Bachelor.

* * *

Lieut.-Col. Lord Dudley Gordon, D.S.O., was re-elected President of the Federation of British Industries for a second year.

* * *

The Minister of Supply appointed Mr. T. F. A. Board as Controller of Molasses and Industrial Alcohol, while Mr. L. P. B. Merri.

* * *

Over a million workers in the engineering industry benefited from an award issued by the National Arbitration Tribunal, which increased the national bonus by 3s. 6d. a week for men.

FEBRUARY

THE first H. E. Armstrong Lecture of the Society of Chemical Industry was delivered on February 3 by Dr. E. F. Armstrong, son of the "Father of British Chemistry."

* * *

Mr. Edward Herbert Clifford, a consulting mining engineer, who was co-opted as a member of a committee set up to inquire into the possibilities of increasing the production of non-ferrous ores in the United Kingdom, was elected President of the Institute of Mining and Metallurgy.

* * *

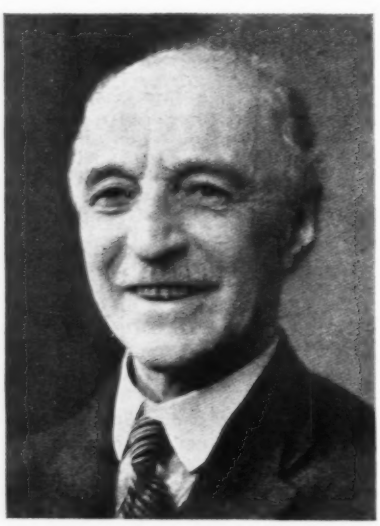
An anonymous donor entered into a deed of covenant with the University of Birmingham, for a period of seven years, to provide a valuable fellowship in chemistry to be known as the Chamberlain Research Fellowship.

* * *

For his distinguished contributions to organic chemistry, Sir James Irvine, principal of St. Andrews University, was awarded the Gunning Victoria Jubilee prize.

* * *

Mr. George Harrison Gemmell, a well-known Scottish analytical chemist, died at the age of 80.



The late Mr. J. W. Towers

One of the foremost leaders in the American movement to give aid to Britain, and a chemist of high repute, Professor James Bryant Conant, President of Harvard University, left for London at the head of a special mission appointed by President Roosevelt.

The death on February 23 of Mr. J. W. Towers, who had been associated with the chemical world from his earliest manhood, was a sad blow to the industry. He was founder and chairman of J. W. Towers & Co., Ltd., of Widnes, Liverpool, and Manchester, manufacturers of scientific apparatus and pure chemicals. This famous firm, established in 1882, rapidly gained a high reputation as laboratory furnishers, and had for some time been contractors to H.M Government.

MARCH

DR. A. J. ROBERTSON, who died in Glasgow in his 62nd year, was a noted worker in the field of industrial analytical chemistry.

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Dr. J. J. Fox, Government chemist, was re-elected President of the Institute of Chemistry.

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At the annual meeting of the Institute of Metals, Lieut.-Col. the Hon. R. M. Preston, D.S.O., was re-elected President. It was announced that Dr. Paul D. Merica had been presented with the platinum medal for 1940.

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By the death of Mr. J. G. A. Rhodin, F.I.C., chemistry in Britain, and especially electrochemistry, lost a brilliant master. Born in Sweden, he had the distinction of being one of the only two foreigners who remained members of the Institute of Chemistry after the alteration of its rules in 1920.

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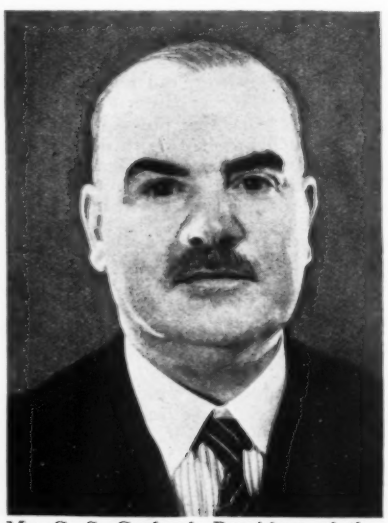
Although at the time marked only by a luncheon and the annual general meeting, the centenary of the Chemical Society was none the less an auspicious occasion. Professor J. C. Philip was elected President.



Mr. C. S. Garland, President of the Institution of Chemical Engineers

APRIL

SIR CECIL WEIR, K.B.E., M.C., was appointed Controller-General of Factory and Storage Premises.

* * *

Attending the annual meeting of the Institution of Chemical Engineers, Mr. A. V. Alexander delivered an address at the luncheon which preceded the meeting. Mr. F. Heron Rogers retired from the presidency to which Mr. C. S. Garland was elected. One of the founders (1924) of the Institution, he had previously served as a Member of Council, Hon. Registrar, and Vice-President.

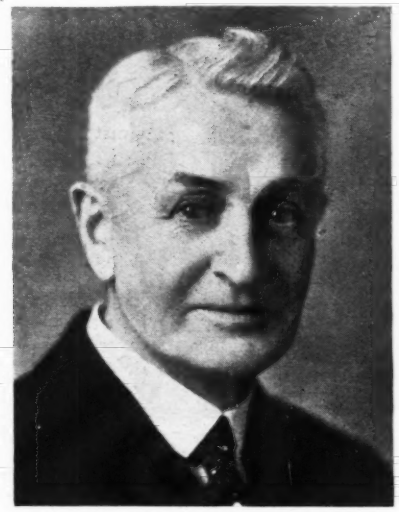
* * *

Sir Lawrence Bragg, F.R.S., and Dr. Charles Darwin, F.R.S., arrived in Ottawa to establish a liaison between scientists in England and those in Canada and the United States respectively.

Noted in the field of both inorganic and organic chemistry, Professor Arthur Lapworth, F.R.S., died in his 69th year. The University of Manchester will always owe him a debt of gratitude for his devotion to the furtherance of its chemistry departments.

* * *

Severe air raids took a heavy toll of life during the first part of the year. Among the hundreds of victims on the night of April 17 was Lord Stamp, whose work as a director of I.C.I. will long be remembered in the chemical industry.



Dr. William Cullen, President of the Society of Chemical Industry

MAY

AT the 18th annual meeting of the British Chemical and Dyestuffs Traders' Association, Mr. Victor Blagden was re-elected President.

* * *

Lord Suffolk, who died as a result of enemy action on May 12, was posthumously awarded the George Cross for conspicuous bravery in connection with bomb disposal. He had come into scientific prominence through his liaison work between British and French Government scientists.

* * *

Lieut.-General A. G. L. McNaughton, G.O.C. 1st Canadian Corps, Overseas Force, and President of the National Research Council of Canada, lectured on "Research in Canada" at a meeting of the Royal Society of Arts.

* * *

Dr. C. H. Desch, F.R.S., Past-President of the Institute of Metals, was awarded the Institute's platinum medal at the meeting of the Institute at Oxford. The three previous recipients of the medal were Sir William Bragg, F.R.S., Sir Harold Carpenter, F.R.S., and Dr. Paul D. Merica.

* * *

Lord Austin died at the age of 74. Principally associated with the motor industry, he was a generous friend to science generally. In 1936 he presented £250,000 to Cambridge University for the extension and further endowment of the Cavendish Laboratory.

JUNE

MR. WINSTON CHURCHILL became an honorary Fellow of the Royal Society and Dr. J. B. Conant was elected to foreign memberhip.

* * *

Lord Cadman, D.Sc., F.R.S., chairman of the Anglo-Iranian Oil Co., Ltd., and the Iraq Petroleum Co., Ltd., died at the age of 63.

* * *

Said to be the world's largest powder factory, the plant of Messrs. E. I. du Pont de Nemours at Charleston, Indiana, began operating 23 days ahead of schedule.

Mr. H. E. G. West, general manager of the chemical works of Newton Chambers & Co., Ltd., was appointed managing director of the company, for the purpose of co-ordinating its divers interests. Mr. West joined the company 22 years ago.

* * *

A baronetcy, conferred upon Mr. Francis D'Arcy Cooper, was among the list of birthday honours.

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Dr. Thomas Midgley, chairman of the board of directors of the American Chemical Society, was awarded the Priestley Medal.

JULY

IN succession to the Professor J. C. Philip, O.B.E., F.R.S., Dr. William Cullen was appointed President of the Society of Chemical Industry. Addresses were given by the retiring President and by Sir Robert Pickard, the Society's Medallist for the year. As in the previous year, the whole proceedings occupied only about three hours instead of the five or six days customary in peace-time.

* * *

Lieut. G. G. Turner, R.N.V.R., a director of Alec Parsons, Ltd., manufacturing chemists of Manchester, was awarded the George Cross for great gallantry and undaunted devotion to duty.

* * *

Industry lost one of its leaders by the death of Mr. H. J. Mitchell at the age of 64. Beginning as an office boy in the Nobel Dynamite Trust in 1893, he rose to be President of I.C.I. from 1936-1938 and was a director until his death, which broke a personal association with Lord McGowan of 40 years standing.

AUGUST

PROFESSOR J. C. PHILIP, O.B.E., F.R.S., D.Sc., LL.D., died suddenly in a nursing home on August 6 at the age of 68. With his death the science and industry of chemistry lost an outstanding figure; he was among the most distinguished and best known personalities in the profession.

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State science bursaries, tenable at universities and certain technical colleges, were set up by the Board of Education to provide an inflow of new scientific talent.

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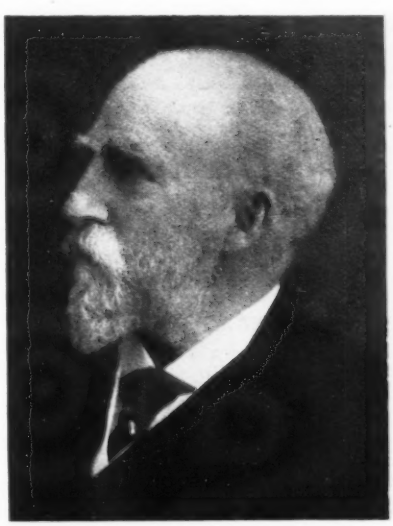
Sir R. Robinson, Waynflete Professor of Chemistry at Oxford, was awarded the Swiss Society of Chemistry's highest honour, the Paracelsus gold medal.



The late Mr. William MacNab

The death of Mr. A. B. Purvis occurred when an aircraft in which he was travelling crashed after taking off.

He was chairman of the British Supply Council in North America and for the greater part of his life had been closely connected with the chemical industry both in this country and in Canada, where he was president of Canadian Explosives, Ltd., later reorganised by him into Canadian Industries, Ltd.

SEPTEMBER

MR. WILLIAM MACNAB, consulting chemist, who died in his 84th year, was President of the Institution of Chemical Engineers in 1934. He was a member of Lord Moulton's famous Committee on Explosives in 1914, and for his work as technical adviser to the Ministry of Munitions (Explosives Supply Dept.), during the last war he was created C.B.E. in 1920. With MacNab's death the chemical industry lost one of the leading authorities on explosives chemistry among the older generation.

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Professor A. G. Green, who died on September 12, at the age of 77, was formerly director of research, British Dyestuffs Corporation, and Professor Chemistry (Dyestuffs) at the University of Leeds.

* * *

In succession to Sir Robert Robinson, Dr. William Hobson Mills, M.A., F.R.S., was elected president of the Chemical Society. He was chosen a Fellow of the Chemical Society in 1898 and served on the Council for six years. He is a Longstaff Medallist of the Society, Davy Medallist of the Royal Society, and Fellow and Lecturer of Jesus College, Cambridge.

Dr. W. H. Mills, President of the Chemical Society

OCTOBER

EMINENT food chemists met at Cambridge to discuss the foundation of the Nutrition Society which was later established under the chairmanship of Sir John Orr.

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At the 25th annual meeting of the Association of British Chemical Manufacturers, Mr. Roger Duncalfe became president for the ensuing year and Mr. C. F. Merriam was elected chairman.

* * *

Mr. J. Clark, the chemist who was dismissed from a Royal Ordnance factory after he had written an article criticising management at the works, was given a similar position at another Royal Ordnance factory.

* * *

The Rt. Hon. Lord Armstrong, who died at the age of 78, was chairman of the Thermal Syndicate, Ltd., Wallsend.

NOVEMBER

FUEL and Power Controllers were appointed in the Civil Defence Regions to co-ordinate the activities of various Government departments.

The committee which, under the chairmanship of Lord Henley, considered low-temperature carbonisation processes last year, was invited to reassemble to examine the sources of fuel for producer-gas vehicles.

The late Mr. J. M. Bush

Mr. J. M. Bush, who died on November 20, age 78, was the third son of William John Bush, founder of W. J. Bush & Co., Ltd., manufacturers of fine chemicals and distillers of essential oils. J. M. Bush began work in the factory 62 years ago, shortly before the death of his father he was admitted into partnership; and in 1903 he became chairman and managing director. This position he held until his death.

DECEMBER

JAPAN declared war on the U.S.A. and Great Britain, spreading the conflict until four-fifths of the human race were involved, and threatening the tin and rubber supplies of Malaya.

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Dr. A. E. Dunstan was elected President of the British Association of Chemists. The main theme adopted by speakers, both at the luncheon and afterwards at the annual meeting, was the pressing need for chemists to unite into one body.

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In succession to Dr. E. F. Armstrong, F.R.S., Mr. Roger Duncalfe, President of the A.B.C.M., was appointed Chairman of the Chemical Divisional Council of the British Standards Institution.

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The Perkin Medal of the Society of Chemical Industry was awarded to Dr. Martin H. Ittner. The medal is awarded annually for outstanding work in applied chemistry.

* * *

Sir Francis D'Arcy Cooper, chairman of Lever Brothers and Unilever, Ltd., and chairman of the Executive Committee of the Export Council, Board of Trade, died at the age of 59. Years of intense activity in commerce and in the interests of the nation led in 1939 to a serious illness from which he never fully recovered.

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The year ended with the publication of the new scientific quarterly, *Endeavour*, aimed at countering the flood of German scientific propaganda. Though sponsored by I.C.I., the journal is entirely non-commercial, and has the co-operation of the British Council.

The Coal Carbonisation Industries in 1941

by G. E. FOXWELL, D.Sc., F. Inst. P.

Dr. G. E. Foxwell

THE coal carbonisation industry, comprising the three branches of gas works, coke ovens, and low temperature carbonisation, is the most important single coal-using industry in the country. It carbonises some 40 million tons of coal a year, which is between one-fourth and one-fifth of the total coal output in normal times. It supplies gas to domestic consumers and industry; it supplies coke for domestic consumers, industry, and export; it supplies numerous by-products, among them being sulphur, which is principally used in the manufacture of sulphuric acid, and tar, which is the basis of the tar industry. Benzol also is of peculiar importance at the present juncture. The operation of the industry is complicated by the fact that coke and gas production must be balanced. On the coke-oven side this balance is a matter of economics. Coke ovens exist for the production of coke. Primarily they were based wholly upon metallurgical coke, but since the early 1920's more and more coke has been made for the general coke market in which it formerly competed with, and is now sold in collaboration with, gas coke. Large quantities of coke-oven gas are sold to the gas industry and large quantities are also used in the steel works.

It is now established that the best possible practice from the angle of low fuel costs is to instal combined iron and steel works, including blast furnaces, steel furnaces, reheating furnaces and rolling mills, on a central site on which are also sufficient coke ovens to provide the fuel for the steel works. These ovens should be heated by blast furnace gas which has a C.V. between 90 and 105 B.Th.U. per cu. ft. gross, and the rich oven gas, generally with a C.V. of 500 to 550 B.Th.U. gross, should be used for the steel furnace. To a great extent the British iron industry was modernised before the war so that this practice, or some reasonable modification of it, had already been applied fairly generally. Thus the production of coke and gas is automatically balanced because both are used internally. There are instances, however, where works of this character have surplus coke-oven gas which is sold to neighbouring gas companies.

Difficulties of Economic Operation

The colliery-owned coke ovens supply some coke for the iron and steel industry, but most of their make now probably goes into the general market. From the point of view of economic operation it is essential that a reasonable return should be secured for the gas, and this has led to difficulties, especially during the year under review. Coke ovens have contracted to supply industrial works or gas undertakings with minimum quantities of gas which have had to be supplied whatever the condition of the coke market. The export market for coke has been the Continent of Europe and particularly the Scandinavian countries. With the disappearance of this export market there has been a reduced market for coke. Limitation of transport has made it difficult to move coke freely up and down the kingdom and the result has been that with the increased war-time demand for gas considerable quantities of coke have been accumulated in some places.

On the gas side the balancing of coke and gas production is simpler, because gas undertakings can make use of water-gas installations to produce part of their gas. The position is broadly that there has been a shortage of coke each winter during the war and this shortage has been made up as far as possible by bringing oven coke into areas remote from the coalfields.

A special difficulty faced by many gasworks is that caused by war-induced movement of the population. In some places the gas industry has been faced with a residential population, much of which has evacuated because of defence regulations, because of migration to distant works, or for other reasons connected with the war. It may therefore have been necessary to keep the undertaking going with reduced load which may in some places be less than half the normal peace-time load; this leads to a difficult financial position. On the other side of the picture there are gas undertakings which have had a great influx of population in their area, often accompanied by increased industrial demand, and they have been called upon to supply a greatly increased quantity of gas with the same plant. Sometimes this has been possible; at other places plant extensions have become imperative irrespective of whether the additional plant will be utilised after the war. When to these abnormal conditions are added the difficulties of working during the black-out and in some instances when enemy aircraft have been overhead, it can be understood that the gas industry has had considerable difficulties to face. It is greatly to the credit of the industry that these difficulties have been faced and overcome without public knowledge even of their existence.

As if these difficulties were not enough, there has been added to them a lack of appreciation on the part of the Mines Department of the quality of coal required for gas manufacture. Great efforts have frequently been made by local coal authorities to persuade a gas works to take deliveries of coal which were completely unsuitable for gas production; sometimes these efforts have been successful and the difficulties of the gas manager have thereby been multiplied. The Coke Oven Managers have likewise had their black-out and other war-time difficulties. A prolonged stoppage of charging with modern rapidly coking ovens leads to a rapid fall in the C.V. of the gas and also in the rate of gas production, so that it becomes difficult to maintain the heats.

The carbonising industries are key industries in the war effort. The provision of coke and gas is of vital importance and it is not surprising that some works have been the subject of intensive enemy attack. Precautions have been taken by the gas industry in collaboration with the Government which will nullify the effects on war production of enemy attack on gas undertakings.

The Importance of Benzol

It has been pointed out that benzol is of vital importance to our war effort. During the last war this fact was stated freely and special plant was installed whereby toluol could be produced while leaving the benzol in the gas—that at least was the theory of it though in practice it did not work out that way. Very little has been said about toluol in this present war and until quite recently it was not generally recognised by gas engineers, in spite of the work of the Benzol Advisory Committee, that toluol was urgently needed. There is, of course, still something to be done in these directions, but a good deal has been achieved by purely voluntary means. The fundamental

difficulty, however, has been that the gas manager has been under statutory obligation to keep up his supply of gas; he has been under no such obligation to remove benzol from his gas. He has, therefore, quite rightly insisted that whenever the continuity of the gas supply was theatened owing to shortage of coal or too great a load on his gas making plant, or for any other reason, the benzol plant should be the first to be cut off. Towards the end of 1941 this was changed by a Board of Trade Order which directed that all works possessing benzol plants must compulsorily operate them in such a way as to recover the maximum amount of toluene from the gas. A similar order was applied to the coke-oven industry. This Order does not, however, relate to works having no benzol plants and it appears to fall short in other respects of what might have been expected.

The American Toluene Position

In view of the American situation it is of interest to record the American toluene position as disclosed in published papers. The amount of toluol available from the coke-oven industry in America is 30 million gallons per year. From the gas industry there is available certainly not more than in 1918, possibly less than 9,000,000 gallons. At the beginning of 1941 it was considered that the possible requirements would be between 40,000,000 and 60,000,000 gallons, far more than the gas and coke-oven industries between them could produce. The only source from which the deficit could be made up is the oil-refining industry. Toluol from an oil refinery was unheard of before 1917, but during the latter part of that year and in 1918 research work was done and one or more methods developed for toluol production directly from oil cracking. Since that time, the advancement in the art of oil cracking, and in the use of catalytic processes, has produced in the oil-refining industry a tremendous potential for toluol production, but little, if any toluol was being produced by it at the start of 1941. It seems, however, to be the only source from which the deficit above referred to can be made up. An important point is that neither the American gas industry nor the oil refineries were then ready to start production. The by-product coke industry was already in full production. Some units of the gas industry are in production now, but in most situations heavy construction work must be done requiring from six months to one year from date of starting before any toluol-bearing oil can be produced. The condition in the oil industry is very similar. No units were then in production, and six months to one year will be required to get them into production. It is understood that the Shell Oil Company have planned to build at Houston, Texas, a toluol plant having a capacity of 2,000,000 gallons per year, but whether this has been erected or not is not known. These figures indicate the paramount importance of the recovery of every possible gallon of benzol in Great Britain.

Fuel rationing has been a live subject each winter, and it was at one time proposed to initiate an extensive rationing scheme for domestic fuel consumption. The representations that were made by the gas and electrical industries, however, sufficed to show that this was not practicable and the much more sensible step has been taken of appealing to the public to reduce their consumption of fuel to the lowest possible amount. It is believed that this will be sufficient for the purpose and that nothing more will be heard of fuel rationing unless severe weather causes it in certain districts. Unfortunately, a good deal of paper has been wasted over this fuel conservation campaign.

Among the Government Orders effecting the carbonising industries mention should be made of the Control of Coal Tar Order, which prescribes that no one shall acquire or dispose of any coal tar except under licence. Special directions have been issued in relation to anthracene and phenol. The utilisation of tar products for the replacement of imported petroleum products has been given considerable importance during the year. A paper on the subject of pitch burning was read by Mr. E. Brett Davies before the Institute of Fuel in October last (*see* THE CHEMICAL AGE, November 22, p. 267).

The predominant subjects of discussion during the year have been the marketing of coke and the reorganisation of the gas industry. The marketing of coke has involved close collaboration between the coke-oven industry and the gas industry. This collaboration has been advancing very satisfactorily during recent years, but unfortunately there is an unwillingness on the part of certain colliery interests to take their full share in the arrangements. Unless this attitude is materially modified and both industries pull their full weight there is danger that the arrangements will fall through and that after the war there will be a price-cutting competition which can only end in disaster to both industries. It is necessary that all should recognise that the best bargain is one that will result in strength throughout the whole coke industry and not one that will give temporary financial benefit for a few months to any particular firm or group of firms.

The Institution of Gas Engineers held in June a one-day symposium of papers on the reorganisation of the gas industry with a view to post-war development. As a result of this meeting several Committees of the Institution have been appointed to consider what positive steps should be taken. THE CHEMICAL AGE published one of the papers in full on June 14, 1941, p. 333. During the course of this meeting the opinion was freely expressed that the gas industry did not stand as high in the opinion of Government circles as it should do, and there was obviously apprehension lest some scheme of Government reorganisation should be forced upon the industry. These fears have fortunately now been largely allayed by the appointment in September of Dr. E. W. Smith to be Director-General of Gas Supply. Dr. Smith is to have the assistance of Messrs. J. F. Ronca, George Evetts, and P. Chantler, to which number was later added Mr. Fottrell of the National Gas Council. The Directorate of Gas Supply is to deal with questions immediately relative to the public supply of gas to nationally essential factories, and to advise on steps to secure the progressive development of the industry as a public service. It is now felt that the organisation of the gas industry will proceed on proper lines sponsored from within the industry and not from without. In the writer's opinion a similar method should be taken to reorganise the coke-oven industry. This industry should be made independent of colliery control, and there should be compulsory powers to achieve a unified policy throughout the industry in the production and disposal of coke.

Smokeless Fuels

There is before the carbonising industries a very great opportunity. The Government has appointed Lord Reith as Minister of Reconstruction. Under Lord Reith there will be reconstruction of housing to replace houses damaged or destroyed by the war and to clear away slums and other blots upon our social services. It is unthinkable that a committee operating in the year 1942 should allow smoke to continue after the war. From the point of view of health, or minimising damage to property and structures, and of saving labour in the house, smokeless fuels—gas, coke, electricity, and smokeless coals—must be actively encouraged and possibly imposed by law. The carbonising industries, if they are prepared to handle the business on modern lines, are faced with their greatest opportunity. The coming years will see how this opportunity develops and whether they are in a position to grasp it.

Sulphamic acid and ammonium sulphamate, which were costly laboratory curiosities three years ago and had few known uses, are now in large production by E.I. du Pont de Nemours and Co. A price reduction of some 50 per cent. has been announced. Both the products mentioned have been found of value in many industrial processes. Ammonium sulphamate is being widely adopted in the U.S. as a fire retardant in textiles, insulation products, and paper; inflammable material treated with ammonium sulphamate will char upon contact with flame, but will not blaze. Workers' uniforms, for example, in plants where fire-hazard is high are being protected on an increasing scale with ammonium sulphamate. Sulphamic acid is valuable in leather tanning for nitrite removal, for dyes and colour lakes, and as a laboratory reagent. This white crystalline solid is odourless, highly soluble in water, non-volatile and non-hygroscopic.

Chemical Industry in India

The Struggle for Self-Sufficiency

THE heavy chemical industry in India is making rapid strides forward. Among the recent developments is the production of soda ash, synthetic ammonia, caustic soda, chlorine, bleaching powder and bichromates. A factory for stabilised bleaching powder at Rishra under Imperial Chemical Industries, another at Khewra for soda ash, and a third one at Port Okha for heavy chemicals are expected to start production in the near future. Machinery for a project of manufacturing 10 tons of sulphuric acid per day in Bombay has already been ordered and the factory is under erection.

Among acids, hydrochloric and nitric acids are manufactured in sufficient quantity, but their manufacture, like that of alums and of sulphate of copper and magnesium, is dependent on sulphuric acids which in turn depends on the supply of sulphur. The main supply of sulphuric acid comes from Tatas, the Digboi Oil Company, and the Assam and Mysore Chemical and Fertiliser Works. In ordnance factories, however, nitric acid is made by oxidation of ammonia. Only one factory is so far using Simla pyrites for producing sulphuric acid, according to the current issue of *Science and Culture*, but, as a result of recent finds of pyrites in South India, factories in this region are also contemplating using pyrites.

Sulphur Resources

The large deposits of high-grade rock sulphur in Baluchistan, mentioned in THE CHEMICAL AGE for August 30, have so far not been worked owing to the lack of fuel and water required to purify crude sulphur. Trials are under progress to see whether the crude can be burnt by appropriate admixture with the commercial quality imported from abroad. The deposits of rock sulphur discovered at Koh-i-Sultan are estimated to possess some 85,000 tons of sulphur-bearing rock with an average sulphur content of about 60 per cent., although larger quantities of this high grade material may be looked for. A further 300,000 to 400,000 tons of 35 per cent. sulphur-bearing rock can be obtained by mining at another locality near Sanni which can be developed to yield more from the lower strata. Dr. C. S. Fox of the Geological Survey of India is of opinion that altogether some 500,000 tons of sulphur-bearing rock carrying roughly 35 per cent. sulphur may be available.

A method of obtaining sulphur by pyrites burning has been developed recently by the Board of Industrial and Scientific Research. Pilot plant experiments have shown that this process enables pure sulphur to be produced at a reasonable price. In this process by-product iron oxide is also obtained, which can be used in the paint industry. This process by itself would ensure a continuous supply of sulphur, as there is plenty of iron pyrites available in India.

Acetates and Bichromates

On the outbreak of the war the Supply Department gave the incentive for increased home production of acetic acid, lead acetate, sodium and potassium bichromates, and caustic alkalis. The normal imports of acetic acid are 300 tons and those of bichromates 1000 tons per annum. A small acid factory near Ahmedabad produces annually 300 tons of acetic acid from acetate of lime supplied by Mysore. A firm in Bengal is trying to produce the acid by further fermentation of alcohol. For organic acids like tartaric, citric, and oxalic, India still depends on imports from abroad. A firm in the Punjab has just started manufacturing oxalic acid and it is considered that sufficient raw materials are available for manufacturing tartaric and citric acid. Boric acid is produced in small amounts by a Calcutta firm.

The market for chlorine is now being partly supplied from Indian sources. Production of caustic soda, liquid chlorine, and bleaching powder has started, though the by-product hydrogen is at present wasted into the atmosphere. Any enterprise such as a vegetable oil hydrogenation plant, erected in the vicinity of these factories, could profitably use this pure hydrogen. Of other chemicals, ammonium sulphate has already been manufactured to a limited extent as a by-product of the coking industry, and synthetic ammonia is being produced for conversion into nitric acid required for explosives.

Demand for khaki dyed cloth and the fact that India is well provided with chromite ores have given rise to a number of fair sized factories manufacturing bichromates of soda and potash. Madras, Mysore, Bombay, and Cawnpore have each a plant producing 30 to 40 tons per month. Small factories at Lahore, Calcutta, and Bombay producing 5 tons a month have also sprung up. The present demand of about 500 tons of sodium bichromate a month is, however, largely met by imports from Britain and the U.S.A. The present heavy demand is only a temporary one, and this industry will need considerable technical improvements in manufacturing methods to stand on its own feet after the war.

Methyl alcohol, acetone, and calcium have been produced as by-products of the destructive distillation of wood to produce charcoal for iron and steel production. Acetone has also for some time past been produced from acetate of lime at an ordnance factory. A new process will shortly be introduced in ordnance factories for its production by the oxidation of alcohol. Ethyl alcohol is obtained in large quantities from molasses, a by-product of the sugar industry. Sodium hydrosulphide is being produced in Bengal. Production of ammonium chloride from indigenous raw material has increased and all essential chemicals for water sterilisation and clarification are now reported to be manufactured in India.

OIL ABSORPTION OF PIGMENTS

Several theories have been advanced to account for the oil adsorption of pigments, *i.e.*, the amount of oil necessary to transform the dry pigment powder into a paste. A very simple suggestion has recently been made by I. N. Sapgir (*Coll. J. Russ.*, 1940, *6*, 853). Let the volume ("bulk volume") taken up by 1 g. of pigment powder in air be v. When the air between the pigment particles is displaced by oil, the volume of oil required will be not very different from that of air, *i.e.*, $v - \frac{1}{d}$, $\frac{1}{d}$ being the volume of the pigment particles and d the specific gravity of the pigment. If the specific gravity of the oil is D, the weight of the oil required is $D(v - \frac{1}{d})$ g. per gram of pigment. The oil adsorption in the usual units is then $100\ D(v - \frac{1}{d})$ per cent. The oil adsorption thus calculated fits experimental data for many pigments including white lead, red lead, soot, ochre, titanium oxide, etc. Iron rouge and zinc white were the only exceptions encountered.

VITAMIN K

Successful application of vitamin K, the blood-coagulation vitamin, is reported from Canada. Medical authorities there are stated to have saved many lives already by its use. Prepared from fish-liver meal and alfalfa, it is water-soluble and fat-soluble and can be administered orally. It has been principally used in the treatment of jaundice and internal hæmorrhage. Chemically a point of interest is the close analogy between the structure of K_1, one of the vitamin K factors, with that of vitamin E, but the full significance of this fact awaits completer investigation.

Personal Notes

MR. L. W. FARROW and MR. J. F. MILNE have been appointed by the Ministry of Supply to the Rubber Control Board. Mr. Farrow will serve as deputy-chairman.

DR. H. A. THOMAS, Ph.D., B.Sc., F.I.C., F.C.S., technical manager of Courtaulds, Ltd., Droylsden, has been elected a member of the Textile Institute.

MR. VERNON PROCTOR, O.B.E., has been appointed Regional Controller for the Ministry of Supply in the East and West Ridings of Yorkshire in succession to Mr. J. K. Anderson.

DR. GEORGE A. SMITH, formerly Assistant Provincial Chemist, has been appointed Provincial Chemist of Nova Scotia, in succession to PROFESSOR L. C. HARLOW, who retires after 30 years' service. Professor Harlow is, however, remaining on the staff of the Provincial Dept. of Agriculture in order to complete the compilation of data which he has collected on soil surveys.

DR. P. C. C. ISHERWOOD, O.B.E., Ph.D., F.I.C., managing director of W. J. Bush and Co., Ltd., has been appointed chairman and managing director of the company, and president of its associated companies, W. J. Bush and Co., Inc., of New York and W. J. Bush and Co. (Canada), Ltd., of Montreal, succeeding Mr. J. B. Bush, whose death was announced in our columns on November 22 last.

MR. PAUL RYKENS (joint chairman of Lever Brothers and Unilever N.V. until the outbreak of war) and MR. HERBERT DAVIS, C.B.E., have been elected joint vice-chairmen of Lever Brothers and Unilever, Ltd., in the place of MR. GEOFFREY HEYWORTH, whose appointment as chairman was announced in our last issue. Mr. Davis remains seconded for duty with the Ministry of Food. MR. ARTHUR GODFREY SHORT has been appointed a member of the board and MR. CHARLES EDMUND TATLOW has relinquished the office of advisory director.

Mr. Heyworth has an exceptional knowledge of manufacturing and marketing at home and abroad. Born at Birkenhead and educated at Dollar Academy, he joined Lever Brothers' Overseas Department 30 years ago. In 1915-18 he served with the Dominion Forces; in 1925 he went to Port Sunlight and in 1929 he was appointed chairman of Joseph Crosfield and Sons, Ltd., soapmakers, of Warrington, an associated business. When he was elected to the board at Unilever House, London, in 1931, he was one of the youngest directors in the history of the company. With the rank of Major he commands his local company of the Home Guard in Surrey.

Mr. Geoffrey Heyworth, whose election as chairman of Lever Brothers and Unilever, Ltd., we announced last week

New Control Orders

Cadmium

THE Minister of Supply has made the Control of Metals (No. 6) (Cadmium) Order, 1941 (S.R. & O., 1941, No. 2090), which came into force on January 1. It provides that no person (other than a consumer of 10 lb. or less per month) shall acquire cadmium-bearing ores, concentrates, or residues, or cadmium in the form of ingots, sticks, or rods, or scrap material containing more than 50 per cent. of cadmium, except under the authority of a licence. Scrap which will not be treated beyond cleaning and sorting is exempted from this provision. Cadmium anodes of ball type and imported anodes of plate type are also made subject to licence on sale or disposal. The Order fixes a maximum price of 5s. 4d. per lb. for cadmium ingots, sticks, and rods, delivered to buyers' premises in lots of 1 cwt. or more. For smaller quantities a maximum of 5s. 6d. per lb. has been fixed.

Nickel and its Alloys

The Control of Non-Ferrous Metals (No. 7) (Nickel) Order, 1941, also of January 1 (S.R. & O. 1941, No. 2091), provides that no person (other than a consumer of not more than 1 cwt. a month) shall acquire unwrought nickel, alloys containing not less than 90 per cent. of nickel, and any scrap material (other than iron and steel scrap) containing more than 5 per cent. of nickel, excepting under licence. Scrap which will not be treated beyond cleaning, crushing, and sorting is exempted from this provision.

Exclusion of Molybdenum and Tungsten from Control

The Minister of Supply has made the Control of Iron and Steel (No. 18) Order, 1941, which came into force on January 5.

This Order varies the existing Control Orders by removing from their scope molybdenum and tungsten metal, except in powdered or sintered form, as other forms of these metals will in future be dealt with by the Ministry of Aircraft Production.

The quantity and value of tinplate, terne plate, etc., which can be purchased by any one customer without licence has been reduced, but it will now be possible to purchase small quantities of these from other than stockholding merchants.

Certain adjustments are made of the extras to the prices scheduled to the No. 15 Order to meet the case of new products or processes which have been developed or expanded under war conditions.

Machinery, Plant and Appliances

New provisions affecting machinery licensing are contained in the Machinery, Plant and Appliances (Control) Order, 1942 (S.R. & O. 1942, No. 1) issued by the Board of Trade. The Order replaces the whole of the previous Machinery and Plant (Control) Orders and Machinery Plant and Appliances (Control) Orders, with the exception of the three General Licences (S.R. & O., 1941, Nos. 777, 1164, and 1392), and embodies certain amendments and additions.

The new provisions have the effect of subjecting to licence machinery and plant for dyeing made-up goods and of exempting from licence (a) machinery, plant, and appliances supplied to a manufacturer of machinery or plant not included in the Schedule to the Order, and for use with any such machinery, plant and appliances made or in course of construction and (b) prime movers or electrical machinery or plant for driving machinery or plant for the supply of which a licence has been granted under the Orders and for which driving means is not already available. Application forms for licences to acquire machinery falling within the Schedule to the Order may be obtained from the Machinery Licences Division, Board of Trade, 1-6 Tavistock Square, London, W.C.1.

NEW APPARATUS IN 1941

A representative selection of the new apparatus placed on the market in 1941 by firms in the chemical and allied trades is illustrated below

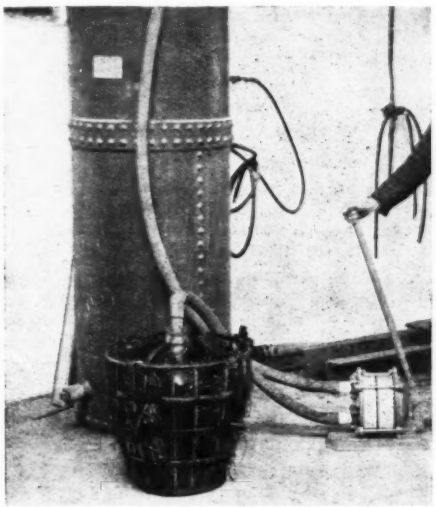


Fig. 1. Small hand-operated portable pump manufactured by L. A. Mitchell.

Fig. 2. Single-unit electrochemical analysis apparatus with automatic current controller by Griffin and Tatlock.

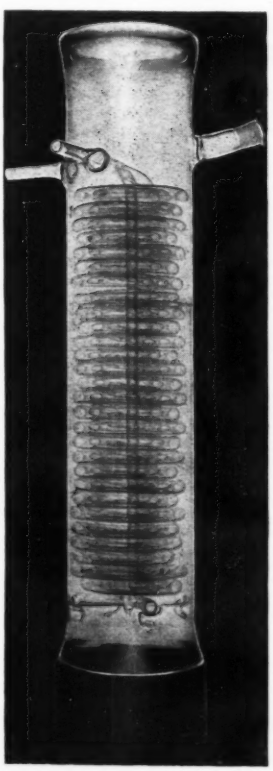


Fig. 4.

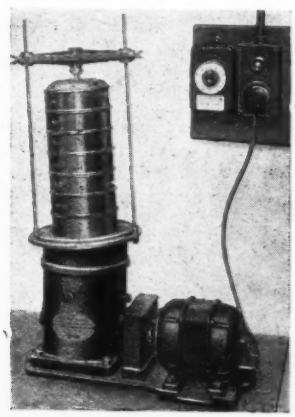


Fig. 3.

Fig. 3 (above). "In-clyno" test-sieve vibrator, a product of the Pascall Engineering Co.

Fig. 4 (left). Reflux condenser manufactured by Quickfit and Quartz.

Fig. 5 (right). Stoneware vacuum filter incorporating a porous ceramic plate made by Doulton & Co., Ltd.

Fig. 5.

General News——From Week to Week

Owing to lack of available information in present circumstances, the Statistical Bulletin of the Tin Research Institute will no longer be published.

Particularly welcome in these days of paper shortage is the calendar which Messrs. Robey and Co., Ltd., of Lincoln, have kindly sent us.

Exports of Canadian merchandise to the United Kingdom in the first 11 months of 1941 totalled $609,800,000, compared with $478,150,000 and $298,800,000 respectively in the corresponding periods of 1940 and 1939.

An officer of the Ministry of Economic Warfare stated in a broadcast recently that Vichy is responsible for almost the only leak in our blockade—phosphates, iron ore, manganese, ground nuts for margarine, hides, graphite being among the cargoes that reached Marseilles from French Africa and elsewhere.

Fines amounting to £1600 and 100 guineas costs were awarded against David Gold, of 113 Park Avenue, Willesden Green, at Thames Police Court recently, under the Control of Molasses and Industrial Alcohol Order, 1941, for illegal dealings in black strap molasses. At the same time, Zems, Ltd., were fined £400 with 40 guineas costs, for transactions of a similar nature.

Real and personal property in Bulgaria, Finland, Hungary, Rumania, and in Japan and the Japanese Empire, belonging to persons and companies of British nationality, resident or registered in the United Kingdom of Great Britain and Northern Ireland, is now eligible for inclusion in the Register of British property in enemy territory.

The following have been elected officers of the British section of the International Society of Leather Trades' Chemists for the forthcoming year: President, R. O. Phillips, M.Sc., M.I.Chem.E.; vice-president, D. Burton, M.B.E., D.Sc., F.I.C.; members of committee, R. Faraday Innes, F.I.C., P. S. Briggs, B.Sc., T. I. Pound; hon. secretary, A. Harvey.

Among the 368 additions to the black list of traders in neutral countries with whom trading is illegal, contained in the Trading with the Enemy (Specified Persons) (Amendment) (No. 21) Order, 1941, which came into force on December 24, is the name of Soc. des Usines Chimiques Rhône-Poulenc, Dardagny, near Geneva. A new order (No. 22), containing a further 391 additions to the black list, came into force on January 6.

Maximum prices for saccharin and dulcin have been established by the Minister of Food in the Saccharin (Control and Maximum Prices) Order, 1941, dated December 30. In the schedule attached thereto, maximum prices for a saccharin (*o*-benzoylsulphimide) range from £4 18s. 4d. per lb. for more than 16 oz. to £6 12s. per lb. for not more than 1 oz.; the maximum price for dulcin (*p*-phenetylcarbamide) is £6 per lb.

The alternating system of double filtration, described in a paper by Dr. A. Parker, before the Institution of Chemical Engineers and the Chemical Engineering Group (*see* THE CHEMICAL AGE, December 13, p. 299), is the subject of Water Pollution Research Technical Paper No. 8 (H.M.S.O., price 4s.). Results of the researches undertaken by the Water Pollution Research Board on the subject are therein explained in full detail, with a copious supply of diagrams and photographs.

Eire customs duty and package tax are suspended until June 30, 1942, on the following articles: oils and fats which are glycerides and are wholly or mainly of vegetable origin, soaps, soap powders, and soap substitutes (including sulphonated products of alcohols), but excluding sodium carbonate, sodium silicate, caustic soda, potassium carbonate, caustic potash, ammonia and borax when those substances are imported otherwise than as part or ingredient of any article or preparation.

The Register of Enemy Debts, compiled by the Finance Department of the Board of Trade, is extended to include all debts and other monies owing to persons, including companies and partnerships, in the United Kingdom from persons who by reason of the application of the Trading with the Enemy Act, 1939, to Japan and territories in Japanese occupation become enemies. The Register is extended to include also debts and other monies owing from persons in certain other parts of China.

A chart entitled "Rubber Data for the Engineer" has been issued by the Rubber Publicity Association, 19 Fenchurch Street, London, E.C.3, and a copy will be sent free to any of our readers who apply for it at that address. It is of the well-known concentric type, with two "windows" which, as the upper circle is rotated, reveal the properties and applications of the various types of rubber listed on the margin of the lower circle.

Speaking at the London Commercial Club on Tuesday, the Minister of Economic Warfare, Mr. Hugh Dalton, said: "I am pleasantly surprised at the poor quality of German synthetic fibres. Part of the trouble is caused by German soap, 75 per cent. of which is now not much more than chalk, while only 25 per cent. is fatty content. You could not have a better example of how one part of the blockade helps another. Shortage of fats makes the Germans not only dirty, but cold as well."

Messrs. Richard Smith, Ltd., chemical manufacturers and tar distillers, of Glasgow and Paisley, have just completed their 100th year of existence. The founder, Richard Smith, born near Bristol in 1811, built the chemical works which still bear his name in Glasgow, after a period of managing a small chemical factory at Bow Common, near London. He died in the works in 1865. He was succeeded in management by his sons, Ernest (to 1890) and Wilfrid (to 1932), and now his grandson, Mr. Kenneth Barge, is managing director of the company.

As the result of a poll taken on Wednesday last week, on resolutions submitted at the annual meeting of British Emulsifiers, Ltd., held on December 18, a complete change of control of the company has occurred. It was announced by the chairman, Mr. J. C. Sheather, that the report and accounts for the year ended September 30, 1941, were not adopted; the retiring directors, Mr. G. H. Lamb and Mr. J. P. C. Danny, were not re-elected; the auditors, Messrs. Cape and Dalgleish, were not re-appointed; and that Mr. Nathan Chinn, Mr. George S. James and Mr. Michael M. Berger were appointed directors.

Forthcoming Events

An open conference on the general topic of "Science and the War Effort" will be held in London under the auspices of the **Association of Scientific Workers,** on **January 10** and **11,** from 10 a.m. to 5 p.m., in the Caxton Hall, Westminster. The conference will be opened by the President of the A.Sc.W., Mr. R. A. Watson Watt, F.R.S.

A joint meeting of the **Institution of Chemical Engineers** and the **Chemical Engineering Group** will be held on **January 12,** at 2.30 p.m., in the Rooms of the Geological Society, Burlington House, Piccadilly, W.1, when a paper on "Evaporation of Liquids in Currents of Air" will be presented by Dr. S. H. Wade, A.R.C.S., D.I.C.

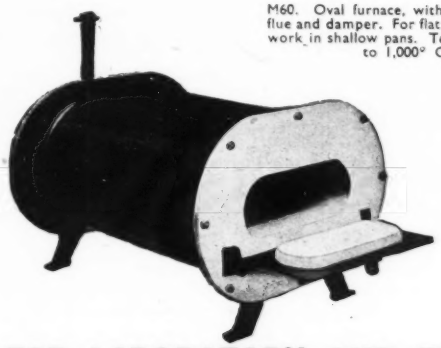
The Leeds Section of the **Institute of Chemistry** will meet on **January 12,** at 6.30 p.m., in the University of Leeds, when Mr. S. Ellingworth, M.Sc., will give a lecture on "Chemotherapy."

Dr. A. A. Houghton, B.Sc., Ph.D., D.I.C., A.I.C., will deliver a lecture on "Some Interesting Properties of Cellulose Ethers" before the Manchester Section of the **Oil and Colour Chemists' Association,** on **January 14,** at 2 p.m., at the Engineers' Club, Albert Square, Manchester.

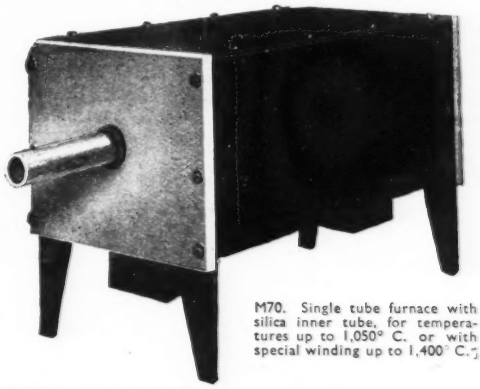
On **January 17,** at 2.15 p.m., a joint meeting of the Manchester Section of the **Institute of Chemistry** with the **Chemical Society,** will be held at Manchester University, when Professor A. R. Todd will speak on "The Chemistry of Hashish."

The first of the series of Cantor lectures this year will be on the subject of "Soil Physics: Theory and Practice," and will be delivered by Dr. B. A. Keen, D.Sc., F.R.S., Deputy Director, Rothamsted Experimental Station, at the **Royal Society of Arts,** John Adam Street, Adelphi, W.C.2, beginning at 1.45 p.m. on **January 19, 26,** and **February 2.**

Mr. James Kewley, M.A., F.I.C., M.I.Chem.E., M.Inst.P., will deliver a lecture entitled "Evolution in the Petroleum Industry" before a meeting of the **Royal Society of Arts,** John Adam Street, Adelphi, W.C.2, on **January 21,** at 1.45 p.m.



M60. Oval furnace, with flap door and flue and damper. For flat work and small work in shallow pans. Temperatures up to 1,000° C.



M70. Single tube furnace with silica inner tube, for temperatures up to 1,050° C. or with special winding up to 1,400° C.

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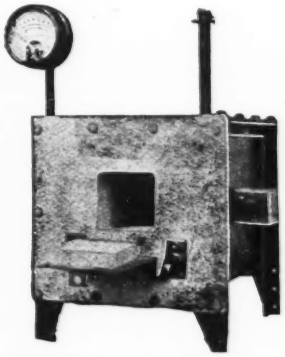

M51. Rectangular furnace with flap door, flue and damper and circular-pattern pyrometer. Chamber, 8 in. by 3 in. by 3 in.

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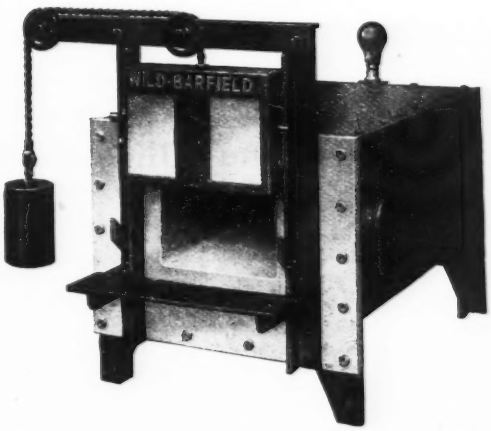

M54. Rectangular furnace with counterbalanced door and excess temperatures cut-out. For temperatures up to 960° C. Several sizes with chambers up to 18 in. by 9 in. by 9 in.

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Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

B. K. L. ALLOYS, LTD., Birmingham. (M., 10/1/42.) December 13, charge, to Founders Court Nominees, Ltd. (as nominees of Brown, Shipley and Co.), securing all sums at any time owing to Brown, Shipley and Co. in respect of the company's liabilities, whether as guarantors or borrowers; general charge. *—. June 15, 1939.

CLAY AND SON, LTD., London, E., manure manufacturers. (M., 10/1/42.) December 8, by order on terms, £850 charge, to Mrs. M. M. Martin, Little Burstead; charged on Springfield, Theydon Bois. *£8715. March 10, 1941.

LANGLEY ALLOYS, LTD. (Bucks.). (M., 10/1/42.) December 4, mortgage, to Swiss Bank Corporation securing £887 7s. 3d. and further advances; charged on certain machinery. *£65,000 floating charge. July 14, 1941.

TAMPIMEX OIL PRODUCTS, LTD., London, W.C. (M., 10/1/42.) December 4, £20,000 (not ex.) charge, to Merchants and General Finance Corporation, Ltd.; general charge. *—. September 14, 1941.

Satisfactions

VIOSULFAL, LTD., London, W.C., soap, etc., manufacturers. (M.S., 10/1/42.) Satisfaction December 17 of debenture registered February 12, 1940.

ALBERT PRODUCTS LTD., Erith, dealers in resins, etc. (M.S., 10/1/42.) Satisfaction December 6 of mortgage registered February 9, 1939.

Company News

Dussek Bros., Ltd., report profit for the year ended October 31 last of £21,090 (£24,594), and have declared a final ordinary dividend of 8½ per cent., making 12½ per cent. for the year (same).

Villa Laboratories, Ltd., Collier Lane Works, Carlisle, have increased their nominal capital beyond the registered capital of £1000, by the addition of £1000. The additional capital is divided into 1000 5 per cent. non-redeemable preference shares.

Wm. Neill and Son (St. Helens), Ltd., have declared a final dividend of 2d. per share, less tax, on ordinary, making 5d. per share for year ended March 31, 1941 (same), and an interim dividend of 1½d. per share, less tax, on account of year ending March 31, 1942 (same).

Chemical and Allied Stocks and Shares

IN most sections of the Stock Exchange small but widespread improvement has been shown in security values. The trend in British Funds again assisted sentiment, and in many other directions prices were inclined to show ready response to moderate improvement in demand, there having again been very little selling. Among industrial securities, those of concerns with interests in the Far East remained depressed, but elsewhere, demand was in evidence for shares of companies that are playing an important part in the war effort and can reasonably be expected to secure favourable results in the post-war period. Numerous companies in the chemical and allied industries are included in this category according to current market views, and, as in most instances there is also a strong balance sheet, the shares are firmly held.

Compared with a week ago, Imperial Chemical further improved from 32s. 9d. to 33s., at which the yield on the basis of last year's 8 per cent. dividend compares favourably with that on many other leading industrial securities. B. Laporte remained at 63s. 9d., and were firmly held, the general assumption being that the dividend is likely to be kept at 15 per cent., despite the larger capital in issue. Fison Packard at 36s. 10½d. have been virtually unchanged since publication of the full financial results. There was again activity in British Plaster Board 5s. ordinary shares, which on balance have risen further from 20s. to 21s. 3d. at the time of writing, the current market belief being that the upward trend in the company's earnings is probably continuing. Lever and Unilever were again favoured, in the hope that an improved distribution is in prospect; current estimates range from 7½ per cent. to 10 per cent., which would compare with the 5 per cent. distributed last year. Turner & Newall were active on the report and accounts, and, as compared with a week ago, have moved up from 66s. 10½d. to 68s. 1½d. at the time of writing. On the other hand, Dunlop Rubber remained depressed on uncertainty as to the extent future results will be affected by loss of income from the Far East, but the current price of 31s. 3d. represents the loss of only a few pence on balance for the week. United Molasses were again favoured, and have risen further from 30s. to 31s. 6d. The units of the Distillers Co. remained firm on hopes that the dividend for the year may again be kept at 16½ per cent. These units were 6d. better on the week at 73s. 3d.

Better demand, too, was in evidence for Barry and Staines, which have further improved from 33s. to 33s. 9d. at the time of writing, while elsewhere Nairn and Greenwich were 7½d. better at 60s., in advance of the dividend announcement. British Aluminium were firm at the higher price of 45s 6d. made last week, while British Oxygen moved up further from 66s. 10½d. to 67s. 6d. Triplex Glass 10s. ordinary shares were again active, and at 30s. 6d. were quite well maintained on balance; the yield on last year's 10 per cent. dividend is very small, but over 20 per cent. was then earned on the shares, and the market is taking the view that a slightly less conservative dividend policy may be followed this year.

Most movements in iron and steel issues were small. Dorman Long were 20s. 3d., awaiting the financial results, but Babcock and Wilcox were slightly higher at 45s. 3d. and Staveley improved to 45s. Tube Investments had a steady appearance at 86s. 3d. and Stewarts and Lloyds were 46s.

Elsewhere, Boots Drug had a firm appearance at 36s. 3d., while awaiting the interim dividend. Saugers were 18s. 7½d.; Timothy Whites were 21s. 7½d. Firmness was maintained in Borax Consolidated deferred, which were again 30s. 6d., and Greeff Chemicals Holdings 5s. units were 5s. 7½d. Monsanto Chemicals 5½ per cent. preference shares were again 22s. 6d. British Industrial Plastics 2s. shares remained at 3s. 3d., and Erinoid transferred up to 7s. 9d. Business at 49s. 6d. was recorded in Thos. De La Rue. Oil shares showed improvement, aided by satisfaction with the maintenance of the "Shell" interim dividend at 2½ per cent., tax free. Cotton textile securities, including Calico Printers and Bradford Dyers, improved on the Government's decision to schedule the cotton industry as vital to war production.

British Chemical Prices

Market Reports

CHEMICAL markets generally have not displayed any special feature during the past week, and for most of the leading items contract renewal arrangements have already been made. In regard to new business the volume of inquiry has been good, with actual bookings governed by the quantities on offer. Prices throughout remain firm with a tendency towards an early advance in quotations in a number of instances. The price of glycerine was advanced by 5s. per cwt., as from January 1. Both the potash and soda sections remain active, with supply difficulties the chief feature, and in the acid section there was a good demand for oxalic, acetic, and boric acids. The position of citric acid remains tight and makers' quotations unchanged at 1s. 5½d. per lb. It is understood that the makers have none to offer, but small quantities of imported material in dealers' hands would be quoted up to 1s. 10d. per lb.

MANCHESTER.—Trading conditions on the Manchester chemical market during the past week have not been unsatisfactory on the whole. In all sections the undertone of prices is extremely firm and a further stiffening here and there has been reported. Delivery specifications under existing contracts are circulating steadily in most sections and additional new business in a fairly wide range of chemicals has been placed. From the point of view of fresh bookings, the tar products market has been again less active than it was a month or so ago, though in crude tar, creosote oil, carbolic and cresylic acids, and the toluols and other light distillates there has been no falling off in the demand against contracts.

GLASGOW.—In the Scottish heavy chemical trade business has been rather quieter during the past week for both home and export business. No doubt this arose owing to the Christmas and New Year holidays. Prices are very firm, with a tendency to rise, as from the beginning of the New Year.

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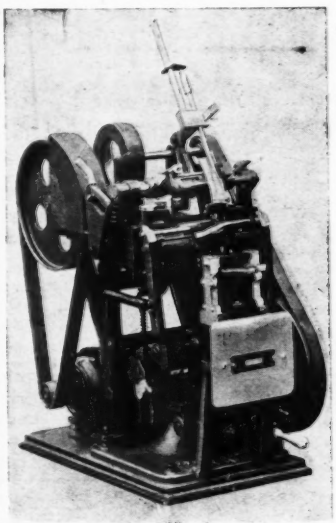

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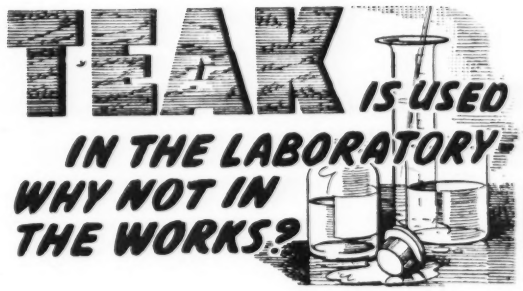

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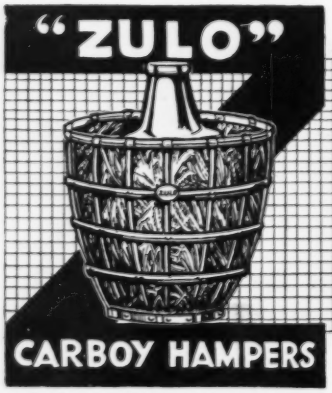

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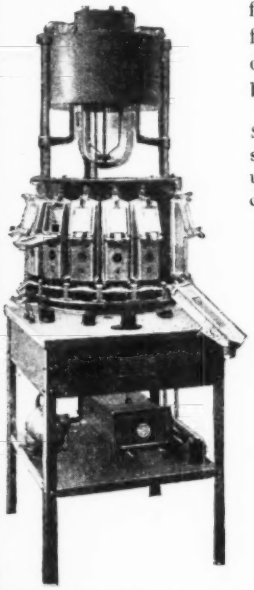

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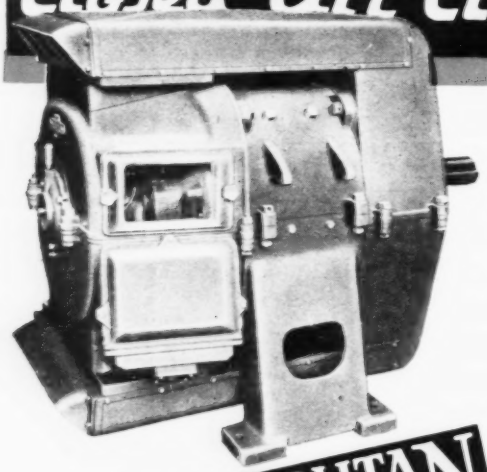

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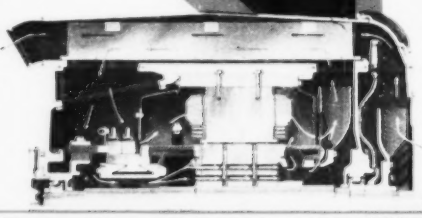

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